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oil & gas environmental assessment

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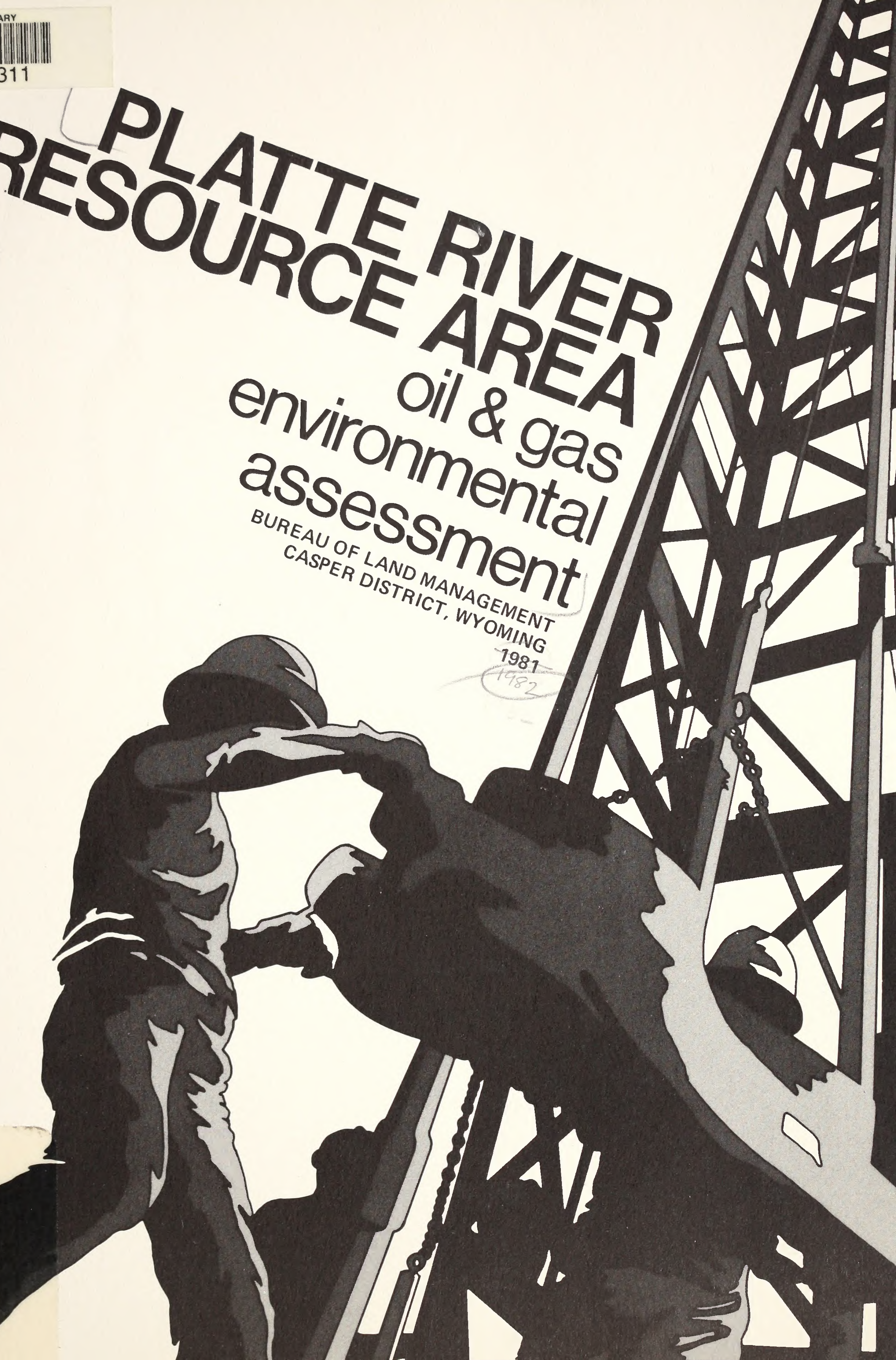

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PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

FOR

OIL AND GAS LEASING

IN THE

PLATTE RIVER RESOURCE AREA

CASPER DISTRICT, WYOMING
BUREAU OF LAND MANAGEMENT
UNITED STATES DEPARTMENT OF THE INTERIOR

EA NO. WY-062-1-13
March 1982

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
District Office
951 Rancho Road
Casper, Wyoming 82601

IN REPLY REFER TO
1792

Dear Reader:

This environmental assessment describes the effects of oil and gas leasing in the Platte River Resource Area of the Bureau of Land Management's Casper District. It also specifies surface protection measures that can be used to reduce the extent of environmental consequences of oil and gas activity.

Platte River Resource Area encompasses Natrona, Converse, Platte and Goshen Counties in Wyoming.

An assessment of this type, which covers an entire resource area, cannot address every possible circumstance, nor can it deal with all site-specific details. However, as the document explains, site-specific assessments are made for each lease before oil and gas exploration can proceed on federal lands.

We invite your comments regarding this environmental assessment. They should be mailed within 45 days to the following address:

Bureau of Land Management
Casper District Office
951 Rancho Road
Casper, Wyoming 82601

Sincerely,

Paul W. Arrasmith
District Manager

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ABBREVIATIONS AND ACRONYMS

ACEC	Area of Critical Environmental Concern
AO	Area of Operation. Assigned for each well by the Geological Survey
APD	Application for Permit to Drill
AUM	Animal Unit Month. The amount of forage necessary to sustain one animal unit for one month. An animal unit is defined as one cow or one horse or five sheep.
bbl	barrel
BLM	Bureau of Land Management, U.S. Department of the Interior
cfs	cubic feet per second
dB	decibel. This measurement of sound is defined in the footnote to table 3-13 in the text.
EA	Environmental Assessment. A record of the environmental factors involved in a land management action.
EIS	Environmental Impact Statement. A written analysis of the impacts of a proposed project.
EPA	U.S. Environmental Protection Agency
FLPMA	Federal Land Policy and Management Act of 1976
FS	Forest Service
gpm	gallons per minute
GS	Geological Survey, U.S. Department of the Interior. In several places in this document, discussion of the responsibilities of GS in oil and gas leasing were written before these duties were reassigned to Minerals Management Service.
MCF	thousand cubic feet
MFP	Management Framework Plan. A BLM land use planning document.
MMS	Minerals Management Service, U.S. Department of the Interior (See GS).
mg/1	milligrams per liter
NEPA	National Environmental Policy Act of 1969
NTL	Notice to Lessee. Prepared by the Geological Survey
SHPO	State Historic Preservation Officer
TDS	total dissolved solids
TSS	total suspended solids
URA	Unit Resource Analysis
USFWS	U.S. Fish and Wildlife Service, U.S. Department of the Interior
VRM	Visual Resource Management. A program to protect scenic values and reduce the impact of development activities.
Wyoming DEQ	Department of Environmental Quality, State of Wyoming

INTRODUCTION

Section 2 of the National Environmental Policy Act of 1969 (NEPA) requires that all programs and activities authorized by the Bureau of Land Management (BLM) be analyzed for environmental impacts. The leasing of federally administered oil and gas estate in the Platte River Resource Area is of major significance to resource management in the Casper District, the Bureau of Land Management, and the state of Wyoming. The Location map shows the four counties in the resource area (RA). Activities resulting from federal leasing, such as exploration, and the subsequent development associated with oil and gas production may have effects on the human environment.

SCOPE OF THIS DOCUMENT

This Environmental Assessment (EA) will analyze and describe the present impacts of oil and gas leasing alternatives in the resource area and the impacts expected through 1990. It will provide the public and the BLM with a description of environmental consequences associated with leasing alternatives to enable them to make better decisions about the multiple resources that could be affected. Areas will be described that are considered to be suitable and unsuitable for future leasing, as will the areas suitable for leasing only under special provisions. Mitigating measures that would reduce environmental effects will also be identified and discussed.

In addition, the EA will analyze all support requirements, both on and off lease sites, that would be necessary for development of a lease, and it will identify impacts of geophysical exploration on land open to leasing. Off-lease developments are rights-of-way for roads, power lines, pipelines, communication sites, material sales, and other related developments associated with lease development. On-lease developments include tank batteries, reserve pits, disposal pits, storage areas, and related facilities.

The Platte River Resource Area has prepared one other EA for the South Big Horn Mountain Area in northwest Natrona County, *Southern Big Horn Mountain Oil and Gas Leasing* (EA No. WY-062-9-52—1979). That EA identifies areas of leasing with restrictions, areas of no leasing, and restrictions that may be applied to leases in the area. Therefore, the portion of Natrona County covered in the previous EA will not be addressed in this document (see Map 1 Appendix 9).

The Salt Creek Drainage Hazardous Area of Critical Environmental Concern has been addressed in the plan element for that ACEC. That area will not be addressed in this EA. See Map 1 in Appendix 9 for a description of that area.

ROLES AND RESPONSIBILITIES

In the Department of the Interior, the expertise in management, protection, and reclamation of all surface resources is with the BLM; the expertise in conservation of minerals, in safety, in drilling and production, and in contact with the operator is with the Minerals Management Service (MMS). The Secretary of the Interior recently reassigned the Conservation Division of the Geological Survey (GS) to the newly created MMS. Most sections of this document were written before this change took place; therefore, MMS now handles certain aspects of oil and gas management that are described in chapters 1 through 4 as GS responsibilities.

The MMS is responsible for rentals and royalty accounting on leases. The two agencies must concur before a stipulation is added to an application for permit to drill (APD), a lease, a subsequent plan of development, or a notice of intent to abandon. The MMS is the approval authority for these actions.

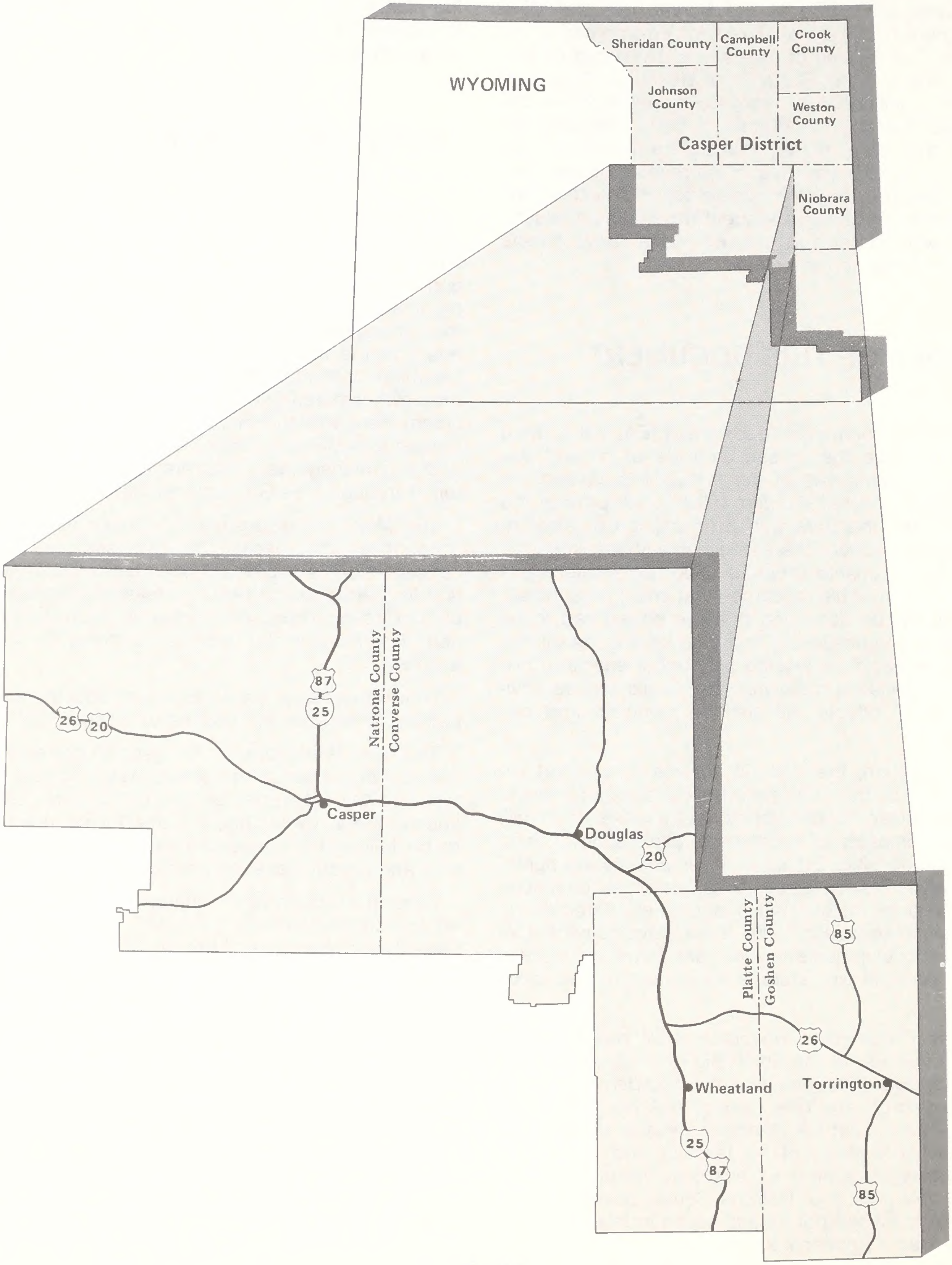
When necessary, the MMS issues detailed explanations to lessees in "notices to lessees" (NTLs).

The BLM is responsible for geophysical exploration and the issuance of rights-of-way on public surface, for the leasing of oil and gas mineral estate under federal ownership, for developing practices to be followed or avoided in geophysical exploration, and for any necessary reclamation.

Leasing of the federal mineral estate is conducted in cooperation with the MMS. The BLM must have the concurrence of the MMS before adding a stipulation to an oil and gas lease. Cooperation and coordination between the two agencies continues throughout lease development and abandonment.

The issuance of rights-of-way for off-lease actions in support of the oil and gas program is the sole responsibility of the BLM. Examples of off-lease actions are access roads, transportation pipelines, and power lines.

When issuing leases on lands whose surfaces are administered by the Forest Service (U.S. Department of Agriculture) and the Bureau of Reclamation (U.S. Department of the Interior), the BLM



Map 1-1
Platte River Resource Area

will follow the decisions and surface protection restrictions made by those agencies. The Forest Service has identified its leasing alternatives in its *Environmental Assessment: Oil and Gas Leasing of National Forest System Lands in the Rocky Mountain Region* (1979).

According to U.S. Code 30, chapter 3A, section 181, national parks and national monuments are exempt from oil and gas leasing; consequently, Fort Laramie National Monument is not available for leasing. The BLM is responsible for making surface protection decisions on all other federal oil and gas estate in the resource area with the concurrence of the MMS.

COMPARISON OF PROPOSED ACTION AND ALTERNATIVES

The following chart presents a consolidated comparison of the proposed action and the alternative described in chapter 2.

COMPARISON OF PROPOSED ACTION AND ALTERNATIVES

	Proposed Action	Alternative
Minerals	Continue present management	Same as proposed action
Watershed (soils) Water Resources	No occupancy or other surface disturbance will be permitted on slopes in excess of 25% (entire resource area)	Same as proposed action
	No surface disturbance within 1/4 mile of North Platte River (16,000 acres)	Same as proposed action
	No surface disturbance within 600' of Laramie River (1,920 acres)	Same as proposed action
	No surface disturbance within 500' of streams, reservoirs, canals (entire resource area)	Same as proposed action
	No surface disturbance within 200' of ephemeral streams (entire resource area)	Same as proposed action
	No occupancy along the rims of or within canyons (29,150 acres)	Same as proposed action
	No occupancy on Cedar Ridge (2,520 acres)	Same as proposed action
	Seasonal restrictions on 258,900 acres for watershed and wildlife	Same as proposed action
	No lease on 8,140 acres	Same as proposed action
Vegetation	Improve reclamation efforts and success on entire area	Same as proposed action
Wildlife	No tree cutting on wild turkey habitat (180,000 acres)	No tree cutting on 1,000 acres critical winter habitat
	Seasonal restriction on elk critical winter range (13,000 acres)	Year-round restriction 17,500 acres
	Seasonal restriction on Bald eagle roost areas (29,000 acres) and 90 miles of river habitat (this includes one ACEC)	Year-round restriction (29,000 acres) 90 miles North Platte river habitat
	Seasonal restriction on critical deer winter range (650,000 acres)	Seasonal restriction on 400,000 acres
	Seasonal restriction on antelope critical winter range (350,000 acres)	Seasonal restriction on 350,000 acres
	Year-round restriction on 4,600 acres of black-footed ferret habitat	Same as proposed action
	Seasonal restriction on 75 sage grouse strutting and nesting grounds (150,800 acres)	Same as proposed action
	No surface occupancy on four wildlife habitat management areas (3,600 acres)	Same as proposed action
Livestock Grazing	No action	No action
Recreation	Exclude two ACECs from mineral exploration and development (20,000 acres)	Same as proposed action
	No surface disturbance within 200' of county, state, and federal roads (27,500 acres)	Same as proposed action
	No surface occupancy on Environmental Education Areas (240 acres)	Same as proposed action
Cultural Resources	No surface occupancy within 200' of five historic trails (25,000 acres)	Same as proposed action
	No surface occupancy permitted on parcels along two trails (6,000 acres)	Reduced restriction on 280 acres
	No surface occupancy permitted on historic sites (960 acres)	Same as proposed action
Visual Resources	Restrictions on 207,000 acres of Class II visual rating area	Same as proposed action

CHAPTER 1: PURPOSE OF AND NEED FOR THE ACTION

PURPOSE, REGULATIONS, AND ISSUES

PURPOSE

The purpose of leasing federal oil and gas is to help meet the national demand for energy fuels in an orderly manner. This also follows the U.S. Department of Interior's energy initiatives and national policy. The BLM, as a part of the Department of Interior, encourages oil and gas development on federal mineral estates by providing the private sector with prompt access to as much of the federal mineral estate with oil and gas development potential as possible. This access is subject to restraints of legislatively decreed responsibilities found in federal and state statutes and in local agency regulations.

Private mineral estate development must meet basic legal mandates, but the BLM has no jurisdiction regarding the leasing or development of these lands, and this document will not address those areas.

LAW AND POLICY

The present BLM policy toward oil and gas leasing is based on both law and BLM instructions as they relate to federal energy mandates. The "Act" in the following quotation is the Mineral Leasing Act of 1920. Subpart 3101.1-1 of 43 CFR says that "All lands subject to disposition under the act which are known or believed to contain oil or gas may be leased by the Secretary of the Interior. Exceptions to this include: Indian Reservations, National Parks and Monuments, incorporated cities, towns, and villages, Naval petroleum, and helium reserves."

BLM policy, as described in the BLM Manual, Part 3000, is "to encourage the orderly development of the mineral resources under its jurisdiction" where such development is consistent with multiple use management and environmental considerations. BLM Manual 3109, Wyoming State Office Supplement, states that "objection to leasing all or part of lands within a lease application" is valid only when impacts of oil and gas exploration or development cannot be satisfactorily mitigated and the surface or environmental values are judged to be greater than the potential oil and gas resource.

Legal restrictions prohibit leasing within incorporated city, town, or village limits; in national parks and monuments, and within 1 mile of naval petroleum reserve boundaries. Lands affected by these restrictions in the resource area are Fort Laramie National Monument in Goshen County and Naval Petroleum Reserve 3 in northeastern Natrona County.

SCOPE OF ANALYSIS

This is a programmatic EA—it does not analyze specific well sites or other specific practices. The primary purpose is to identify overall and cumulative impacts of an assumed rate and type of development, as discussed in the assumptions and analysis guidelines. As individual applications are received, they will be reviewed to determine the applicability of this analysis to the project. If the individual project is determined to be outside the scope of this EA, additional analysis will be completed.

To help determine the major issues that should be discussed in the EA, a scoping workshop was conducted on April 15, 1981. Workshop participants represented a variety of special interests including oil and gas production, environmental protection, ranching, and wildlife management. The following issues were identified:

1. Fencing of abandoned locations until vegetation is reestablished
2. Inclusion of forb and shrub seed in the seed mixture
3. Muffling of pumpjacks, drilling rigs, etc., near sensitive wildlife and recreation areas
4. Methods of keeping waterfowl out of pits
5. Areas of Environmental Concern
    a. Golden eagle nests near Bill, Wyoming
    b. Bald eagle roosts near Antelope Creek in Converse County
    c. Edness Kimball Wilkins State Park
    d. Areas along the North Platte River between Glenrock and Glendo Reservoir, as identified by Wyoming Game and Fish Department
    e. Cody Shale outcrop areas
6. Well pad size

7. Clarification of standard stipulations 4 and 5
8. Reduction of environmental damage and construction cost by placing rig substructure on compacted fill
9. Elimination of spiderweb effect of roads
10. Cereal grain nurse crops added to seed mixture for improved success of rehabilitation
11. Need for improved road construction standards
12. Unrestricted use of roads on public lands

PLATTE RA BACKGROUND

DESCRIPTION

The Platte River Resource Area contains approximately 8.9 million acres in Natrona, Converse, Platte, and Goshen counties, Wyoming. Dominant geographic features of the resource area are the southern extremity of the Big Horn Mountains in the northwest, the Rattlesnake Mountains in the southwest, Casper Mountain near the center, and the Laramie Mountain range in southern Natrona and Converse counties and western Platte County.

Bates Hole, a geologic slump in the Wyoming Basin, is in southeast Natrona County; a small portion of the Wind River basin is in the extreme western part of Natrona County. The rest of the resource area lies in the Northern Great Plains. The major drainages in the RA are the North Platte River, the South Fork of the Powder River, and the Cheyenne River system (Scientific Report 854).

MINERALS

Ownership

Approximately 77 percent of the surface of lands in these counties is in private or state ownership. Sixty-seven percent of the mineral estate on these lands is in private or state ownership, while the remaining 33 percent has been retained by the U.S. Government. The surface ownership distribution of oil and gas mineral estate is described in tables 1-1 through 1-3. All of the federal oil and gas estate under federal, private, or state surface is subject to lease unless restrictions have been applied.

Oil and Gas Activity

The first successful oil well in the resource area was drilled in 1889 just north of the present day Salt Creek Field. The first commercial well was drilled on the Salt Creek anticline in 1908 and produced from the First Wall Creek Sandstone Formation. Major production did not begin until 1917, when the second Wall Creek Formation was drilled. The first refinery in the area was constructed at Casper in 1895. Production of oil in the Salt Creek Field increased from 1895 until 1923, when 35,301,608 barrels were produced. This was 5% of the total production in the United States that year. Total production through the end of 1979 was 689,898,476 barrels (bbls) of oil and 952,686,401 MCF of gas. The Naval Petroleum Reserve 3 was set aside in 1915. Field development was started in 1922 and continued until 1927. Production was resumed in 1964.

As a result of the success in Salt Creek and the Naval Petroleum Reserve, exploration spread throughout the county. The north and south Casper Creek fields were discovered in 1919 and 1925. Other fields discovered were: Cole Creek Field (1938), Grieve Field (1954), Waltman Field (1959), and Frenchie Draw (1961). By the end of 1980 there were 64 field discoveries, 45 of which are currently producing oil, gas, or both.

Between 1970 and 1979, 896 wells were drilled in Natrona County; of those, 349 were dry holes. Table 1-4 and figure 1-1 show the well completions from 1970 through 1979.

The first test hole in Converse County was drilled in 1896. This well produced a small amount of oil. The first significant oil discovery was made in 1916, when Continental Oil Company began development of the Big Muddy Field between Glenrock and Casper. Through the end of 1980, 58 oil and gas fields were discovered; 48 are still producing oil or gas or both. The total cumulative oil produced in Converse County through 1979 was 204,782,738 bbls. Gas production totaled 156,869,891 MCF (Wyoming Oil and Gas Statistics). In Converse County 1,242 holes were drilled between 1970 and 1979; of these, 881 have been producers (see table 1-4).

Very little oil and/or gas development has taken place in Platte and Goshen counties. Two fields were discovered in Goshen County and one in Platte County before 1980. To the end of 1979, 470,605 bbls of oil were produced in Goshen County. Platte County produced 48 bbls of oil and 1,868 MCF of gas. Since 1970, 2 producing wells have been discovered out of a total of 89 wells drilled (see table 1-4).

TABLE 1-1
SURFACE OWNERSHIP DISTRIBUTION
(Area in Acres)

County	Total Surface Area	Private Ownership	% of Total	Federal Ownership	% of Total	State & Local Ownership	% of Total
Natrona	3,471,970	1,710,968	49	1,486,177	43	274,825	08
Converse	2,704,644	2,032,103	75	376,069	14	294,472	11
Platte	1,351,334	1,089,202	81	106,246	08	155,886	11
Goshen	1,402,621	1,267,717	90	27,303	02	107,601	03
Total	8,928,569	6,099,990	68.3	1,995,795	22.4	332,784	9.3

Source: Bureau of Land Management, Wyoming State Office, Records and Data Management, 1981.

* Total county percents are not additive.

TABLE 1-2
DISTRIBUTION OF FEDERAL SURFACE OWNERSHIP
(Area in Acres)

County	Total Surface Area	Bureau of Land Management	% of*6 Total	Forest Service	% of*6 Total	Other	% of*6 Total
Natrona	3,471,970	1,454,036	41.8	5,615	0.1	26,526	0.7
Converse	2,702,644	114,186	4.2	260,621 *	9.6	1,262	0.04
Platte + *5	1,351,334	82,240	6.0	22,864 *3	1.7	---	--
Goshen	1,402,621	26,737	1.9	---	--	566 *4	0.04
Total	8,928,569	1,677,199	18.8	289,100	3.2	28,354	0.3

Source: Bureau of Land Management, Wyoming State Office, Records and Data Management 1981.

* Includes: Water and Power Resources Service, U.S. Park Service.

*2 Includes: Thunder Basin National Grasslands and Medicine Bow National Forest.

*3 Includes: Medicine Bow National Forest.

*4 Includes: Fort Laramie National Monument.

*+5 Includes: Army Reserves Camp at Guernsey.

*6 Total county percents are not additive.

TABLE 1-3
DISTRIBUTION OF OIL AND GAS ESTATE
(Area in Acres)

County	Total Acreage	Federal Oil and Gas Estate *1	% of Total *2	State or Private Oil and Gas Estate	% of Total *2
Natrona	3,471,970	1,269,862	37	2,202,108	63
Converse	2,702,644	1,105,487	41	1,597,177	59
Platte	1,351,334	332,206	25	1,019,128	75
Goshen	1,402,621	203,030	14	1,199,591	36
Total	8,928,569	2,910,585	32.6	6,018,004	67.4

Source: Bureau of Land Management, Wyoming State Office, Records and Data Management 1981.

*1 Includes reservation categories: All minerals, oil and gas, and oil and gas and miscellaneous.

*2 Total county percents are not additive.

TABLE 1-4
ANNUAL WELL COMPLETIONS
(All Ownership)

County	1970			1971			1972			1973			1974		
	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes
Natrona	55	20	31	133	31	48	68	29	44	97	18	22	46	21	28
Converse	48	24	28	66	21	31	61	37	41	122	29	34	159	44	52
Platte	11	11	11	0	0	0	1	1	1	0	0	0	1	1	1
Goshen	21	21	21	2	2	2	11	11	11	4	4	4	6	4	5
Total	135	76	91	201	54	81	141	78	97	223	51	60	212	70	86
Percentage		(56.2%)	(67.4%)		(26.9%)	(40.2%)		(55.3%)	(68.8%)		(22.9%)	(26.9%)		(33.0%)	(40.6%)

County	1975			1976			1977			1978			1979		
	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes	All Wells Drilled	Wild-cats	Dry Holes
Natrona	72	21	45	50	17	28	57	19	31	115	23	39	203	14	33
Converse	315	43	53	119	26	35	113	11	24	123	22	38	116	23	25
Platte	6	6	5	3	2	2	1	1	1	2	2	2	0	0	0
Goshen	4	3	4	5	5	5	3	3	3	3		3	3	3	3
Total	397	73	107	177	50	70	174	34	59	243	50	82	322	40	61
Percentage		(81.3%)	(27.0%)		(28.2%)	(39.5%)		(19.5%)	(33.9%)		(20.6%)	(33.7%)		(12.4%)	(18.9%)

SOURCE: Petroleum Information Corporation Resume.

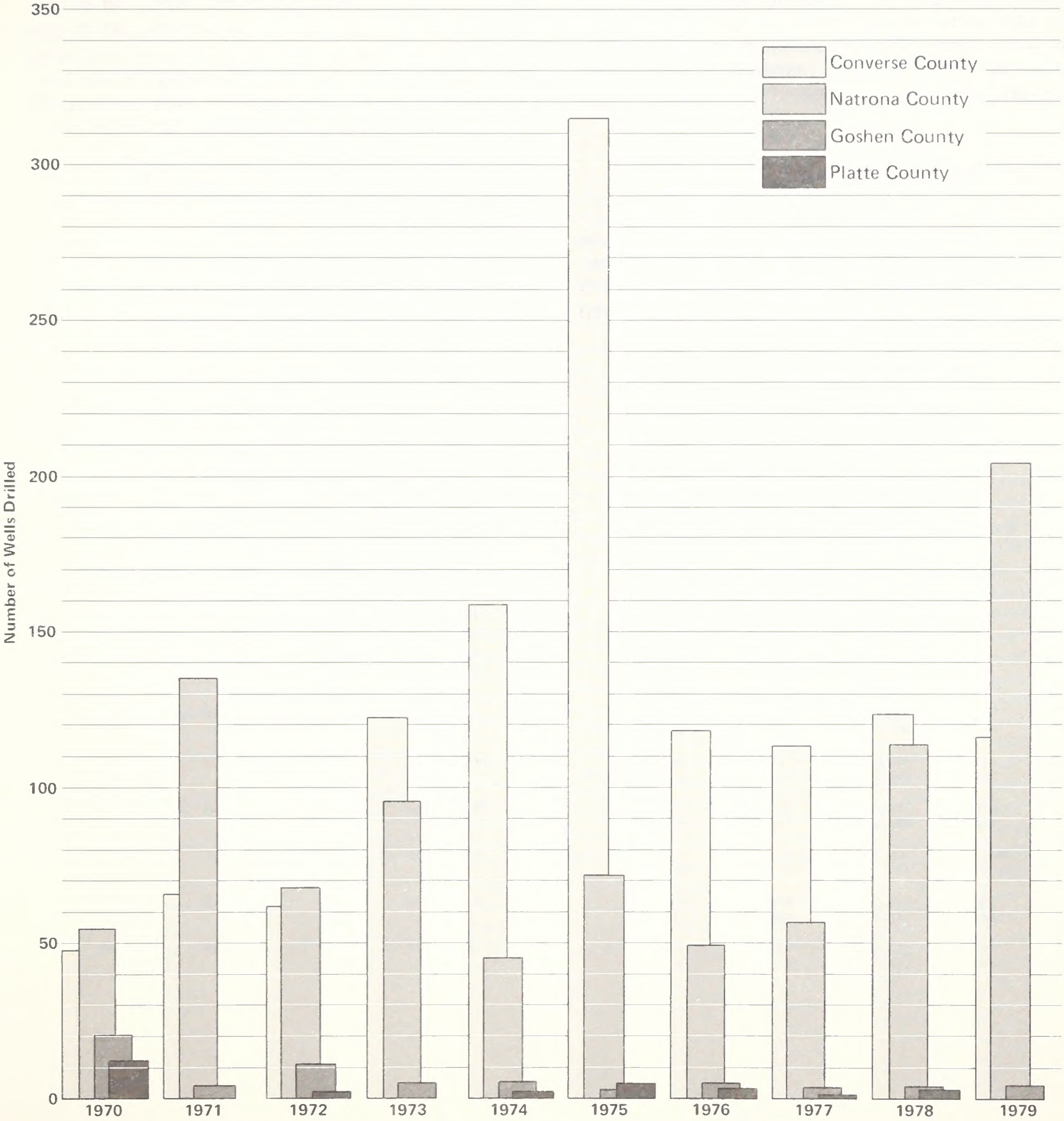


Figure 1-1
Annual Well Completions

There are seven operating gas plants and one oil refinery in Converse County, and three gas plants and three refineries in Natrona County. (Wyoming Oil and Gas Statistics 1979; Barlow and Haun, Inc., 1978). All services necessary for the extraction of oil and gas resources, including seismograph, drilling, transportation, well maintenance services, and dirt work contracting are available in communities within the resource area, primarily in the Casper, Glenrock, and Douglas areas.

Oil and Gas Production

Wyoming ranked sixth among the states in crude oil production in 1979, with 4% of the nation's total. It was sixth in natural gas production in 1978 (1979 figures were not available for gas production) with 1.7% of the nation's total. (Figures from Rick Robitaille, Petroleum Association of Wyoming.) The Platte River Resource Area produced 13% of Wyoming's crude oil and 3% of its natural gas in 1979. Converse County fields accounted for 42% of the Platte RA crude, Natrona County, 57%. All of the resource area's natural gas was produced in the same two counties— Converse County produced 60%, Natrona County, 40% (Wyoming Oil and Gas Commission 1979). The resource area contributed 4.1% of the state's total valuation for crude oil in 1979—approximately $152.4 million—and 0.1% of the state's total natural gas valuation—approximately $31.5 million (Wyoming Oil and Gas Commission 1979).

Tables 1-5 through 1-7 contain specific information on oil and gas production. They also list the producing fields and operating facilities in the RA.

TABLE 1-5
WYOMING OIL AND GAS FIELDS AND UNITS
PRODUCTION 1980

Field or Unit Name	County	First Discovered	Location Twp. Rge.	No Producing Wells	Dec. 1980 Production Oil-bbls. Gas-acf	Cum. 1980 Oil bbls. Gas MCF	Total Cum. Oil bbls. Gas-MCF	Remarks1/
Arminto	Natrona	1924	37 N. 86 W.	0	0 0	0 0	0 0	Oil - ABD Gas
Badwater	Natrona	1957	39 N. 89 W.	1	0 0	0 10,054	0 832,530	Oil Gas
Bates Creek	Natrona	1954	31 N. 81 W.	4	216 0	12,533 72,009	19,341 87,307	Oil - Reactivate Gas - 1979
Bear Creek	Converse	1966	38 N. 75 W.	1	1,393 16,887	15,790 187,189	463,252 2,811,788	Oil Gas
Big Muddy	Converse	1916	33 N. 76, 77 W.	63	12,622 192	147,705 1,560	52,645,918 40,322	Oil Gas
Big Muddy E	Converse	1961	34 N. 76 W.	0	0 0	0 0	2,697,011 0	Oil Gas
Bobby Draw	Converse	1975	36 N. 72 W.	2	251 0	3,472 0	34,075 0	Oil Gas
Bobcat Creek	Converse	1979	38 N. 77 W.	1	858 0	3,271 0	3,271 0	Oil Gas
Bolton Creek	Natrona	1920	29 N. 81 W.	2	70 0	630 0	58,007 0	Oil Gas
Boone Dome	Natrona	1923	35 N. 85 W.	6	277 30,046	2,552 654,178	418,029 30,001,711	Oil Gas
Bower	Converse	1973	37 N. 69 W.	4	1,563	22,687	239,612	Oil Gas
Box Creek	Converse	1955	37 N. 67 W.	3	1,580 3,589	22,190 45,914	101,822 45,914	Oil Gas
Brenning Basin	Converse	1902	32 N. 73 W.	0	0 0	0 0	7,052 0	Oil - ABD Gas - 1956
Brooks Ranch	Converse - Natrona	1957	33 N. 77 W.	21	1,588 0	19,210 0	2,543,115 0	Oil Gas
Brush Creek	Converse	1976	37 N. 72 W.	7	9,595 5,154	67,841 52,571	133,485 106,824	Oil Gas
Buck Draw	Converse	1974	41 N. 73 W.	3	364 36	6,822 9,759	22,777 38,302	Oil Gas
Burke Ranch	Natrona	1953	37 N. 78, 79 W.	15	10,728 1,528	113,025 18,413	6,338,266 214,350	Oil Gas
Burke Ranch E.	Natrona	1971	37 N. 78 W.	4	106 0	4,527 0	74,316 9,640	Oil Gas
Burnt Wagon	Natrona	1976	32 N. 84 W.	5	2,335 19,518	36,682 231,274	220,081 638,680	Oil Gas
Calamity	Converse	1975	39 N. 72 W.	0	0 0	0 0	4,944 291	Oil Temp. Gas - ABD
Carter	Converse	1969	37 N. 68 W.	1	270 122	2,618 3,924	60,292 28,143	Oil Gas
Casper Creek N.	Natrona	1925	36, 37 N. 82 W.	5	1,111 0	16,867 0	545,256 7,290	Oil Gas

TABLE 1-5
(continued)

Field or Unit Name	County	First Discovered	Location Twp. Rge.	No Producing Wells	Dec. 1980 Production Oil-bbls. Gas-acf	Cum. 1980 Oil bbls. Gas MCF	Total Cum. Oil bbls. Gas-MCF	Remarks[1]
Casper Creek, S.	Natrona	1919	33, 34 N. 83 W.	52	18,072 0	215,772 0	10,363,671 0	Oil Gas
Castle Creek	Natrona	1948	38 N. 80, 81 W.	0	0 0	0 0	25,548 1,400	Oil - ABD Gas - 1962
Chug Springs	Platte	1975	24 N. 66 W.	0	0 0	0 0	48 1,868	Oil - SI Gas
Clark Ranch	Natrona	1955	35 N. 84, 85 W.	5	2,405 496	27,490 5,872	1,378,931 177,788	Oil Gas
Cole Creek	Converse - Natrona	1938	35 N. 77 W.	10	3,853 63	50,555 733	17,017,822 501,965	Oil Gas
Cole Creek, S.	Converse	1948	34, 35 N. 76 W.	21	2,448 0	37,268 0	15,871,782 18,557	Oil Gas
Cooper Reservoir	Natrona	1959	35 N. 87 W.	1	0 19,081	0 213,456	0 11,365,391	Oil Gas
Corney	Converse	1979	36 N. 68 W.	5	1,654 1,055	26,423 19,993	28,015 18,521	Oil Gas
Deer Creek	Converse	1950	32 N. 76 W.	0	0 0	0 0	158,282 0	Oil - ABD Gas - 1962
Dilts	Converse	1980	39 N. 72 W.	3	2,040 2,012	9,473 9,256	9,473 9,256	Oil Gas
Don Draw	Converse	1972	36 N. 69 W.	19	9,142 10,378	110,393 125,666	1,066,279 966,263	Oil Gas
Douglas, S	Converse	1946	32 N. 71 W.	5	566 0	5,539 0	98,888 0	Oil Gas
Dry Fork	Converse	1970	38 N. 73 W.	8	8,352 6,056	103,682 81,005	517,893 81,005	Oil Gas
Dull	Converse	1970	40 N. 68 W.	1	0 0	545 0	5,457 0	Oil Gas
Emerald	Natrona	1975	37 N. 84 W.	12	6,769 0	87,975 0	798,915 0	Oil Gas
Fetter	Converse	1979	33 N. 71 W.	0	0 0	0 0	0 0	Oil Gas
Fish Creek	Natrona	1951	31 N. 84 W.	0	0 0	0 0	0 0	Oil - SI Gas
Flat Top	Converse	1961	33 N. 68, 69 W.	37	11,206 124,131	128,424 1,406,992	2,240,566 24,068,920	Oil Gas
Flat Top, E	Converse	1980	33 N. 68 W.	1	0 0	1,081 0	1,081 0	Oil Gas
Fly Draw	Converse	1975	37 N. 75 W.	1	0 0	431 704	18,464 17,822	Oil Gas - SI
Forgey	Natrona	1969	33 N. 87 W.	2	269 0	2,722 4	68,783 62,207	Oil Gas
Frenchie Draw	Fremont - Natrona	1961	37 N. 89, 90 W.	12	1,714 104,894	20,089 946,803	1,014,762 35,916,800	Oil Gas

TABLE 1-5
(continued)

Field or Unit Name	County	First Discovered	Location Twp. Rge.	No Producing Wells	Dec. 1980 Production Oil-bbls. Gas-acf	Cum. 1980 Oil bbls. Gas MCF	Total Cum. Oil bbls. Gas-MCF	Remarks1/
Garrison Draw	Natrona	1971	37 N. 88 W.	0	0 0	0 0	0 0	Oil - ABD Gas
Geary, N	Natrona	1968	34 N. 78 W.	1	94 0	1,166 0	36,470 2,697	Oil Gas
Geary Dome	Converse	1980	34 N. 77 W.	1	5,359 600	29,861 3,107	29,861 3,107	Oil Gas
Gibson Draw	Converse	1970	40 N. 69 W.	0	0 0	0 0	3,020 0	Oil - ABD Gas - 1973
Gilbert Lake	Converse	1960	34 N. 73 W.	0	0 0	0 0	5,082 0	Oil - ABD Gas - 1961
Glenrock	Converse	1949	33, 34 N. 75 W.	5	1,259 0	16,703 0	2,545,878 158,222	Oil Gas
Glenrock, S	Converse	1950	32,33,34 N. 75, 76 W.	73	33,227 684	408,972 8,616	71,353,581 30,312,592	Oil Gas
Government Bridge	Natrona	1956	31 N. 82 W.	3	501 0	5,127 0	1,338,416 7,679	Oil Gas
Grieve	Natrona	1954	32 N. 85 W.	8	3,720 330,911	48,704 3,624,286	29,663,540 64,639,225	Oil Gas
Grieve, N	Natrona	1974	33 N. 86 W.	4	12,704 16,422	133,282 126,131	1,996,532 3,887,119	Oil Gas
Happy Hollow	Converse	1975	34 N. 70 W.	0	0 0	0 0	1,534 8,935	Oil Gas - T.A.
Haps Draw	Converse	1975	38 N. 69 W.	0	0 0	0 0	0 0	Oil - SI Gas
Harvey Draw	Converse	1975	35 N. 71 W.	1	0 0	18 174	2,701 3,600	Oil - T.A. Gas
Hell's Half Acre	Natrona	1976	35 N. 86 W.	0	0 0	0 0	0 0	Oil - SI Gas - 1976
Horse Ranch	Natrona	1955	36 N. 81 W.	5	811 0	12,734 0	150,662 0	Oil Gas
Iron Creek	Natrona	1917	32 N. 82 W.	13	280 0	2,874 4	164,830 4	Oil Gas
Janet	Converse	1968	36 N. 68 W.	0	0 0	0 0	1,528 204	Oil - ABD Gas
Joss	Converse	1968	33 N. 67 W.	3	0 0	0 290	1,029 22,480	Oil Gas
Kaye	Converse - Niobrara	1969	36 N. 67 W.	57	20,711 25,270	271,173 337,357	4,786,474 3,572,865	Oil Gas
Laprele	Converse	1964	33 N. 71 W.	0	0 0	0 0	0 0	Oil Gas
Lebar	Converse	1962	34 N. 70 W.	0	0 0	0 0	235 0	Oil - ABD Gas - 1963
Lox	Natrona	1921	37 N. 86 W.	0	0 0	0 0	0 0	Oil - ABD Gas

TABLE 1-5
(continued)

Field or Unit Name	County	First Discovered	Location Twp. Rge.	No Producing Wells	Dec. 1980 Production Oil-bbls. Gas-acf	Cum. 1980 Oil bbls. Gas MCF	Total Cum. Oil bbls. Gas-MCF	Remarks[1/]
Manning	Converse	1970	29 N. 73 W.	26	14,458 27,143	152,118 319,480	1,324,588 2,214,760	Oil Gas
Martin Spring	Converse	1975	36 N. 74 W.	8	5,986 1,721	80,893 24,496	809,474 160,953	Oil Gas
Mathers	Converse	1976	40 N. 72 W.	2	30 20	744 5,746	3,672 9,139	Oil Gas
Midway	Natrona	1931	35 N. 79 W.	1	152 0	980 0	369,492 0	Oil - SI Gas
Mikes Draw	Converse	1974	36 N. 70 W.	157	81,728 122,973	1,114,213 1,583,862	5,783,531 6,854,575	Oil Gas
Morton	Converse	1967	32 N. 70 W.	8	1,231 0	4,183 0	10,186 0	Oil Gas
Neal Reservoir	Natrona	1978	33 N. 92 W.	2	0 0	0 5,297	219 9,272	Oil Gas
Notches	Natrona	1923	37 N. 85 W.	13	15,243 0	181,953 0	7,202,800 19,972	Oil Gas
Oil Mountain	Natrona	1945	33 N. 82 W.	1	467 0	6,734 0	86,355 11,251	Oil Gas
Okie Draw	Natrona	1953	37 N. 85 W.	1	395 0	7,476 0	62,017 0	Oil Gas
Ormsby Draw	Natrona	1975	38 N. 77 W.	1	0 0	0 0	405 42	Oil Gas - SI
Phillips Creek	Converse	1980	37 N. 74 W.	0	0 0	0 0	0 0	Oil Gas
Pine Mountain	Natrona	1914	35 N. 84 W.	4	276 0	3,593 0	74,605 233,645	Oil Gas
Piney Creek	Converse	1973	35 N. 68 W.	7	3,206 2,695	33,108 28,863	73,972 63,171	Oil Gas
Poison Draw	Converse	1972	39 N. 69 W.	1	2,327 200	8,185 7,600	8,185 7,600	Oil Gas
Poison Spider	Natrona	1917	33 N. 82, 83 W.	35	3,825 0	44,985 0	3,413,328 65,000	Oil Gas
Poison Spider, W	Natrona	1948	33 N. 84 W.	19	33,609 201,787	395,189 2,154,570	8,551,893 24,487,716	Oil Gas
Poison Spring Cr	Natrona	1958	31 N. 84 W.	2	850 230	7,880 2,128	231,078 13,126	Oil Gas
Powder River	Natrona	1930	36 N. 85 W.	1	0 30,353	0 108,808	0 108,808	Oil Gas
Powell	Converse	1954	40 N. 73 W.	33	65,611 179,394	955,356 3,117,082	3,336,163 13,501,253	Oil Gas
Raderville	Natrona	1955	35 N. 89 W.	3	0 0	0 0	103,423 0	Oil - SI Gas
Rat Creek	Converse	1976	38 N. 69 W.	0	0 0	0 0	0 0	Oil - T.A. Gas - 1978

TABLE 1-5
(continued)

Field or Unit Name	County	First Discovered	Location Twp. Rge.	No Producing Wells	Dec. 1980 Production Oil-bbls. Gas-acf	Cum. 1980 Oil bbls. Gas MCF	Total Cum. Oil bbls. Gas-MCF	Remarks[1]/
Raymor Draw	Converse	1976	34 N. 71 W.	1	0 0	0 0	2,246 0	Oil - SI Gas
Ritter	Natrona	1956	31, 32 N. 84 W.	0	0 0	0 0	133,402 7,153	Oil - T.A. Gas - 1978
River Bend	Natrona	1965	30 N. 82 W.	1	0 0	21 0	7,363 0	Oil Gas
Ross(merged w/Powell)	Converse	1975	41 N. 74 W.	0	0 0	0 0	0 0	Oil Gas
Sage Spring Creek	Natrona	1949	36, 37 N. 77 W. 37, 38 N. 78 W.	31	47,948 9,300	563,754 113,379	11,352,312 3,455,778	Oil Gas
Salt Creek	Natrona	1889	39, 40 N. 78, 79 W.	1,115	455,257 0	5,714,479 12	581,687,102 711,185,999	Oil Gas
Salt Creek, E	Natrona	1951	40 N. 78 W.	8	7,254 1,187	100,234 13,669	11,821,511 803,799	Oil Gas
Salt Creek, S	Natrona	1917	39 N. 78 W.	0	0 0	0 0	228 0	Oil - SI Gas
Salt Creek, W	Natrona	1917	39, 40 N. 79 W.	14	243 0	4,734 0	1,751,039 4,003	Oil Gas
Schrader Flats	Natrona	1961	31 N. 82 W.	3	1,964 0	22,820 0	1,929,850 19,696	Oil Gas
Scott	Converse	1979	36 N. 71 W.	94	115,440 84,094	1,140,597 716,165	1,487,613 842,906	Oil Gas
Shannon	Natrona	1889	40, 41 N. 78, 79 W.	0	0 0	0 0	7,124 0	Oil - ABD Gas - 1969
Shawnee	Converse	1936	32 N. 69 W.	1	1 0	183 0	76,184 0	Oil Gas
Sherwood	Natrona	1954	40, 41 N. 77 W.	3	3,198 0	25,258 0	1,519,752 23,367,065	Oil Gas
Smith Canyon	Natrona	1966	35 N. 84 W.	0	0 0	0 0	0 0	Oil - ABD Gas
Smoky Gap	Natrona	1956	40 N. 80 W.	36	323 0	11,607 0	542,554 10	Oil Gas
Soda Lake	Natrona	1980	34 N. 78 W.	0	0 0	0 0	0 0	Oil Gas
Spearhead Ranch	Converse	1973	39 N. 75 W.	34	17,306 285,242	424,024 4,520,041	4,842,305 38,807,089	Oil Gas
Spindle Top	Natrona	1922	29, 30 N. 81 W.	10	64 0	1,018 0	172,064 0	Oil Gas
Spindle Top, N	Natrona	1959	30 N. 81 W.	0	0 0	0 0	1,299 0	Oil - ABD Gas - 1960
Springer	Goshen	1974	23 N. 62 W.	1	84 0	1,026 0	7,136 0	Oil Gas

TABLE 1-5
(continued)

Field or Unit Name	County	First Discovered	Location Twp. Rge.	No Producing Wells	Dec. 1980 Production Oil-bbls. Gas-acf	Cum. 1980 Oil bbls. Gas MCF	Total Cum. Oil bbls. Gas-MCF	Remarks[1/]
Squaw Butte	Fremont - Natrona	1960	36 N. 90 W.	1	0 0	112 18,117	933 257,111	Oil Gas
Steinle Ranch	Converse	1973	39 N. 70 W.	15	21,405 33,459	138,525 264,999	3,241,823 4,389,761	Oil Gas
Swanson Draw, S (merged w/Mikes Draw)	Converse	1973	34 N. 70 W.	0	0 0	0 0	0 0	Oil Gas
Teapot Naval Reserve	Natrona	1922	38, 39 N. 78 W.	490	112,280 255,479	1,487,457 2,180,425	11,411,734 4,802,854	Oil Gas
Teapot, E	Natrona	1927	38, 39 N. 78 W.	58	1,835 0	24,730 0	4,040,797 0	Oil Gas
Teapot, W	Natrona	1970	38 N. 78 W.	0	0 0	0 0	0 490	Oil - ABD Gas - 1970
Tepee	Converse	1972	35 N. 70 W.	1	194 624	2,519 7,598	2,519 7,598	Oil - Reactivate Gas
Tick	Converse	1978	34 N. 71 W.	2	244 310	2,158 2,390	4,163 2,390	Oil Gas
Tipps	Natrona	1963	31 N. 83 W.	2	478	6,551	284,826	Oil
Torrington	Goshen	1955	24 N. 61 W.	2	73 0	1,154 0	465,649 0	Oil Gas
Twenty Mile Creek	Converse	1956	35 N. 68 W.	0	0 0	0 0	31,523 0	Oil - ABD Gas
Twenty Mile Hill	Natrona	1960	36, 37 N. 78, 79 W.	4	1,274 0	15,594 0	1,308,244 124,978	Oil Gas
Wagonhammer	Converse	1954	40 N. 67 W.	0	0 0	0 0	0 0	Oil Gas
Walker Creek	Converse	1977	35 N. 68 W.	1	736 664	9,418 8,493	46,724 45,017	Oil Gas
Wallace Creek	Natrona	1960	34 N. 87 W.	6	1,234 11,090	18,084 313,313	333,659 5,343,142	Oil Gas
Waltman	Natrona	1959	36, 37 N. 86, 87 W.	8	453 284,011	2,400 1,603,457	115,438 42,924,135	Oil Gas
Well Draw	Converse	1973	33 to 36 N. 67 to 70 W.	316	140,951 436,222	1,848,428 5,470,847	18,876,202 29,093,384	Oil Gas
Totals					1,351,651 2,688,484	16,821,363 30,805,211	918,406,659 1,133,265,326	Oil Gas

[1/] SI = Shut In (oil or gas found but not currently being produced)
ABD = Unit Abandoned
P&A = Plugged and Abandoned
TA = Temporarily Abandoned

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming.

TABLE 1-6
SECONDARY RECOVERY FIELDS

Water Injection Projects

Field/Unit	County	Lease/Unit	Source of Injection	Injected Formations	Injectors Active(Inactive)	Year	Operator
Big Muddy	Converse	Wall Creek Unit	Sundance, Dakota Lakota, Wall Creek	Wall Creek	2(47)	1957	Conoco, Inc.
Big Muddy	Converse	Dakota Unit	Sundance, Dakota Lakota, Wall Creek	Dakota	17(14)	1960	Conoco, Inc.
Big Muddy	Converse	Big Muddy Unit	Dakota	Shannon	2(0)	1980	Conoco, Inc.
Big Muddy	Converse	South Block Wall Creek Unit	Tensleep, Madison	Wall Creek	4(2)	1963	J. G. Dyer
Big Muddy	Converse	South Block Dakota Unit	Dakota	Wall Creek	1(2)	1961	J. G. Dyer
Big Muddy	Converse	East Unit	Alluvial	Dakota	2(10)	1961	Arco
Brooks Ranch	Natrona	Brooks Ranch	Frontier	Frontier	1(10)	1966	Terra Resources, Inc.
Burke Ranch	Natrona	Dakota Unit	Parkman	Dakota	3(6)	1962	Arco
Cole Creek	Natrona	Dakota "A" Unit	Parkman	Dakota	5(0)	1970	Mobil Oil Corp.
Cole Creek, S	Converse	Cole Creek Lease	Dakota	Shannon, Dakota	9(18)	1971	Phillips Petroleum
Glenrock, S	Converse	Block "B" Unit	Madison, Tensleep	Upper Muddy	20(15)	1961	Conoco, Inc.
Glenrock, S	Converse	Block "B" Unit	Madison, Tensleep	Lower Muddy	12(17)	1961	Conoco, Inc.
Glenrock, S	Converse	Block "A" Unit	Alluvial	Upper Muddy	0(4)	1967	Arco
Glenrock, S	Converse	Block "B" Unit	Madison, Tensleep	Dakota	27(9)	1961	Conoco, Inc.
Glenrock, S	Converse	Block "A" Unit	Alluvial	Dakota	8(2)	1967	Arco
Grieve	Natrona	Muddy Unit	Muddy	Muddy	1(2)	1970	Forest Oil Corp.
Poison Draw	Converse	Poison Draw	Teckla	Teckla	1(0)	1976	Inexco
Poison Spider	Natrona	Bessemer Ch. 037870	Sundance	Sundance	1(0)	1961	Bessemer Oil Co.
Sage Spring Creek	Natrona	Sage Spring Creek Unit "A"	Parkman	Dakota	5(0)	1972	Cenex
Salt Creek	Natrona	Staley Gov't.	Madison	2nd Wall Creek	10(0)	1964	Terra Resources, Inc.
Salt Creek	Natrona	Light Oil Unit - Lease #1	Madison	1st Wall Creek	165(86)	1956	Amoco Production Co.
Salt Creek	Natrona	Light Oil Unit- Lease #1	Madison, Tensleep	2nd Wall Creek	394(51)	1960	Amoco Production Co.
Salt Creek	Natrona	Light Oil Unit - Lease #1	Madison	3rd Wall Creek	1(16)	1969	Amoco Production Co.
Salt Creek, E	Natrona	2nd Wall Creek Unit	Tensleep	2nd Wall Creek	3(0)	1967	Arco
Salt Creek, E	Natrona	Tensleep Unit	Tensleep	Tensleep	1(10)	1970	Arco

TABLE 1-6
(continued)

Water Injection Projects

Field/Unit	County	Lease/Unit	Source of Injection	Injected Formations	Injectors Active(Inactive)	Year	Operator
Salt Creek, S	Natrona	Salt Creek South Unit	Madison	2nd Wall Creek	92(65)	1962	Terra Resources, Inc.
Teapot Dome	Natrona	Naval Petroleum Reserve #3	Madison	2nd Wall Creek	33(0)		Fenix & Scisson, Inc.
Torrington	Goshen	Torrington "J" Field Unit	Shallow Water Sand	"J" Sand	1(5)	1974	Grace Petroleum Corp.

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming

TABLE 1-6

Gas Injection Projects

Field/Unit	County	Lease/Unit	Injected Formations	Type	Injectors Active(Inactive)	Year	Operator
Poison Spider, W	Natrona	Cody "B" Unit	Cody - Phayles	Pressure Maintenance	9(2)	1974	Union Oil of Calif.
Poison Spider, W	Natrona	Mesaverde "B" Unit	Mesaverde "B"	Pressure Maintenance	1(0)	1970	Union Oil of Calif.

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming

TABLE 1-6

Hydro Thermal Injection Products

Field/Unit	County	Lease/Unit	Injected Formations	Type	Injectors Active(Inactive)	Year	Operator
Casper Creek, S	Natrona	Federal Lease - Cn. 037867	Tensleep	Steam	5(11)	1974	Union Oil of Calif.

TABLE 1-6

Water Disposal Systems

Field/Unit	County	Lease/Unit	Injected Formations	Type	Number of Disposal Wells	Year	Operator
Big Muddy	Converse	Big Muddy	Wall Creek	Water	2	1979	Conoco, Inc.
Bower	Converse	Federal So. Roy.	Teckla	Salt Water	1	1974	Inexco Oil Co.
Don Draw	Converse	State 28 PRE	Lewis	Salt Water	1	1975	Inexco Oil Co.
Flat Top	Converse	Pohl	Lance	Salt Water	1	1978	Terra Resources, Inc.
Glenrock	Converse	No. 1 McNeil 4	1st Wall Creek	Salt Water	1	1975	Phillips Petroleum
Grieve	Natrona	Grieve Unit	Muddy	Salt Water	1	1970	Forest Oil Corp.

TABLE 1-6
(continued)

Water Disposal Systems

Field/Unit	County	Lease/Unit	Injected Formations	Type	Number of Disposal Wells	Year	Operator
Manning	Converse	#1 Federal 44-17	Parkman	Salt Water	1	1978	Champlin Petroleum
Mikes Draw	Converse	Steinle 1-15	Teckla	Salt Water	1	1979	Mitchell Energy Corp.
Poison Draw	Converse	1 Federal Kirby	Teckla	Salt Water	1	1977	Inexco Oil Corp.
Scott	Converse	No. 2 Fowler 21-12	Upper Parkman	Salt Water	1	1981	Louisiana Land & Expl
Well Draw	Converse	No. 4 Hoffman	Teapot	Salt Water	1	1977	Jim's Water Service
Well Draw	Converse	1 Lebar	Teapot	Salt Water	1	1977	Chinook Resources
Well Draw	Converse	1-34 Williams	Lewis	Salt Water	1	1977	Inexco Oil Co.
Well Draw	Converse	1-32 Federal	Teapot	Salt Water	1	1977	Diamond Shamrock

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming

TABLE 1-6

Teritary Projects

Field/Unit	County	Lease/Unit	Type of Project	Injected Formations	Injectors Active(Inactive)	Year	Operator
Big Muddy	Converse	Big Muddy DOE Project	Surfactant	Wall Creek	10(0)	1979	Conoco, Inc.
Salt Creek	Natrona	Salt Creek	Water/Micellar	Wall Creek	4(0)	1972	Amoco Production Co.

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming

TABLE 1-6

Operating Gas Plants

Plant or Field Area	County	Plant Operator	Date of First Report	Gas Intake for 1980 MCF	Annual Production Gallons Hydro Carbons, Propane Butane, Gasoline	Tons Sulfur
Casper	Natrona	Kansas-Nebraska Natural Gas Company, Inc. Phillipsburg, KS 67661	January 1966	13,622,549	9,549,181	None
Douglas	Converse	Phillips Petroleum Company P.O. Box 2920 Casper, WY 82602	November 1970	18,897,329	92,600,938	None
Flat Top	Converse	Kansas-Nebraska Natural Gas Company, Inc. Phillipsburg, KS 67661	January 1962	1,270,659	3,073,989	None
Grieve	Natrona	Sun Oil Company 2525 Northwest Expressway Oklahoma City, OK 73112	January 1970	3,484,719	7,201,267	None

TABLE 1-6
(continued)

Operating Gas Plants

Plant or Field Area	County	Plant Operator	Date of First Report	Gas Intake for 1980 MCF	Annual Production Gallons Hydro Carbons, Propane Butane, Gasoline	Tons Sulfur
Inexco Plant #1	Converse	Inexco Oil Company 1100 Milam Bldg., Ste. 1900 Houston, TX 77002	January 1975	1,307,290	10,105,305	None
Mikes Draw	Converse	Liquid Energy Corporation 3900 One Shell Plaza Houston, TX 77002	December 1977	192,602	1,279,885	None
Powell II	Converse	Sun Gas Company 2525 Northwest Expressway Okalhoma City, OK 73112	January 1977	1,854,796	3,433,591	None
Spearhead Ranch	Converse	Quasar Energy, Inc. 2500 Ft. Worth Nat'l Bank Bldg. Fort Worth, TX 76102	June 1975	5,584,068	11,848,786	None
Well Draw	Converse	McCulloch Oil Corporation 10880 Wilshire Blvd. Los Angeles, CA 90042	August 1974	336,451	1,392,367	None
		TOTALS		46,580,463	140,485,368	

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming

TABLE 1-7
1980 OIL AND GAS FIELD DISCOVERIES

Field Name	County	Sec. Twp. Rge.	Formation	Oil/Gas	Operator
Bobcat Creek	Converse	24-38N-77W	Frontier	Oil	Marathon Oil Company
Dilts	Converse	35-39N-72W	Parkman	Oil	Davis Oil Company
Flat Top, East	Converse	36-33N-68W	Niobrara, Greenhorn Frontier	Oil	W. E. Sauer
Geary Dome	Converse	27-34N-77W	Dakota	Oil	The Anschutz Corp.
Phillips Creek	Converse	16-37N-74W	Frontier	Gas	The Diamond Shamrock Corp.
Soda Lake	Natrona	24-34N-78W	Dakota	Oil	Mosbacher Production

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming

1980 Approved Drilling Permits By County

County	Number of Permits
Converse	211
Goshen	5
Natrona	98
Platte	2

Source: Wyoming Oil and Gas Statistics 1980; compiled by the Wyoming Oil and Gas Commission; Casper, Wyoming

CHAPTER 2: THE PROPOSED ACTION AND ALTERNATIVES

ALTERNATIVES CONSIDERED

DESCRIPTION

The following possible alternatives were initially considered for analysis in this EA:

The Proposed Action, which would result in the continuation of leasing under existing laws and regulations, with current stipulations and restrictions included in the management decisions of three management framework plans (MFPs). These MFPs were developed for the management of public lands in the four counties of the resource area.

Alternative 1, No Leasing, would permit no new leasing for oil and gas development. This would afford a maximum level of protection for all natural resources.

Alternative 2, Leasing with Special Stipulations, would allow leasing under stipulations that could increase or decrease the level of protection currently provided by existing laws, regulations, and standard stipulations.

Alternative 3, Leasing with No Restrictions, would allow leasing without any sort of restrictions or protective measures.

DECISIONS

BLM staff review, as well as public review and comment during the scoping process, resulted in the elimination of Alternatives 1 and 3 from further consideration. These alternatives will not be further analyzed in this document. The rationale for their elimination is as follows:

Alternative 1, No Leasing: This alternative is not consistent with current governmental policy or initiatives to meet growing energy needs through leasing with multiple use management guidelines. Comments received at a public workshop indicated that consideration of such an alternative would not be well received.

Alternative 3, Leasing with No Restrictions: This alternative was found to be inconsistent with the National Environmental Policy Act (NEPA), the Federal Land Policy and Management Act (FLPMA), and management policies related to those laws. Comments received at a public workshop indicated that consideration of such an alternative would not be valid and led to the conclusion that some level of protection was needed through restrictions or stipulations.

This EA documents the analysis of only the Proposed Action and Alternative 2, Leasing with Special Stipulations.

ANALYSIS OF PROPOSED ACTION AND ALTERNATIVE

THE PROPOSED ACTION

The BLM has established criteria for the protection of the environment in the Platte River Resource Area (PRA) through the use of standard stipulations, land use planning through management framework plan (MFP) documents, and reclamation stipulations. Stipulations are applied on a case-by-case basis at the time of the field examination, depending on the requirements of resources at each site. Federal and state regulations, which are covered by a standard stipulation, are described later.

The BLM's proposed action is to continue issuing oil and gas leases in the Platte RA, subject to the standard stipulation, conditions identified in the MFPs, laws, and regulations, and the stipulations applied at the time of the field examination of each site.

ACTIVITIES RELATED TO OIL AND GAS

Activities associated with geophysical exploration, leasing and development, and rights-of-way, as they relate to the proposed action, are described in the following sections.

Geophysical Exploration

Gravitational prospecting detects variations in gravitational attraction caused by the differences in the density of various types of rock. Magnetic methods reveal upheaved structures, which are likely to yield oil and gas, because such structures show a strong magnetic response. Gravitational and magnetic prospecting equipment is usually transported by pickup or helicopter. The only surface disturbance is that caused by the vehicle.

Seismic prospecting is the most popular of the geophysical methods, since it gives the most reliable and reproducible results. Shock waves are initiated with the use of a thumper or vibrator on the surface or by detonating explosives in the bedrock. The waves travel through or are reflected from various rock layers and are received by shock sensors. The sensors are connected to a truck where the shock waves are recorded. The time required for shock waves to travel through the rock formations yields useful information.

Notices of intent for geophysical exploration are required for all lines in their entirety if any portions of the lines cross federally owned surface. Notices of intent are to be filed and processed according to the requirements of 43 CFR 3045 and Wyoming State Office Supplement 3045.

Leasing

The actual leasing of an area is an administrative action, which in itself causes no impact; however, the issuance of a lease authorizes the lessee to explore the leased area actively and to develop it guided by the stipulations attached to the lease. Stipulations, which are attached to the lease when the lessee accepts it, serve to point out possible areas of critical environmental concern.

Oil and gas leases fall into two categories—competitive and noncompetitive. This could change if legislation now before Congress is passed. The proposed legislation would allow the leasing only through competitive bidding for lands within a geologic province considered favorable for the discovery of oil and gas.

All oil and gas leases, whether competitive or noncompetitive, are processed through the BLM's Wyoming State Office (WSO). The Platte River Resource Area manager is the Casper district manager's representative for prelease investigations and recommendations in Natrona, Converse, Platte, and Goshen counties.

Stipulations attached to leases are determined on the basis of the *BLM Manual*, WSO instructions, MFP decisions, and in some cases, field examinations. The BLM and the GS have agreed to ten standard stipulations to be attached to oil and gas leases. In addition, the two agencies have agreed on a so-called wilderness stipulation, a "sage grouse" stipulation, and an archeological clearance stipulation for special situations. Since there are no wilderness areas or potential wilderness areas in the PRA, use of the wilderness stipulation will not be necessary here. The use of standard stipulations pertaining to no leasing requires GS concurrence, as does the use of any nonstandard stipulation. The stipulations are described later in this chapter.

When the potential impacts from oil and gas exploration or development cannot be mitigated and the surface values are judged to be greater than the potential oil and gas resource, no surface occupancy is allowed. The no-surface-occupancy stipulation is to be used only on leases or portions of leases that are 0.5 mile or less wide from the nearest place acceptable for occupancy.

The area manager can recommend no leasing for all or portions of oil and gas leases that are farther than 0.5 mile from any place of acceptable occupancy, because the oil and gas reserves cannot be tapped by directional drilling.

After an oil or gas lease has been issued, the lessee has up to five or ten years, depending on the type of lease, to start actual drilling operations, or the lease will be terminated. An extension of two years may be granted if actual drilling operations are begun before the end of the primary term of the lease and are being diligently pursued over the expiration date. The extension is for as long as oil or gas is produced in paying quantities.

Drilling Operations

Preliminary Environmental Review

The federal lessee or operating company selects the location of a proposed drill site. The selection of the site is based on spacing requirements, the probability of finding hydrocarbons as indicated by geologists and geophysicists, the topography, and the availability of funds for a specific well.

Surveying a proposed well site requires travel over public roads, private roads, and trails, as well as off-road cross-country travel. Since drilling oil and gas wells in the resource area is a year-round activity, surveying, and therefore travel, is done under all weather conditions.

Application for Permit to Drill

After the preliminary environmental review and before any surface activity is conducted in conjunction with the drilling of an oil or gas well, the operator must submit to the GS an APD and an agreement with the surface owner, if the land surface is privately owned. The agreement lists the surface owner's rehabilitation requirements. These requirements, if deemed not unreasonable by the GS and the BLM, are considered to be stipulations to the plan. If a surface owner requests measures that may be harmful to the environment, every possible effort is made to negotiate alternative measures.

The APD is forwarded to the BLM's Casper District, Division of Operations. A presite field inspection is conducted by representatives of the GS, the BLM, lessees or operator, and any other interested party (such as the dirt contractor or surface owner). The purpose of field inspection before drilling is to evaluate the operator's plan, to assess the situation for possible impacts, and to formulate resource protection stipulations.

Stipulations are sent to the GS as condition of approval for a well site. At this time, if the proposed well is on federally owned surface under the jurisdiction of the BLM, the BLM states whether or not it wishes to acquire the oil or gas well for a water well at the time of abandonment.

Before an APD can be approved, the operator must obtain an archeological clearance. This entails at least one trip to the area of the well location and may require cross-country travel in addition to use of public roads, private roads, and trails.

The GS is responsible for preparing an environmental impact assessment before an APD is approved. GS then gives final approval of an APD, and the operator may commence construction activities.

Preparation for Drilling

After the APD is approved, the GS assigns an area of operation (AO) to each well. For exploratory wells, the AO assigned to an oil well is 160 acres; a 640-acre area is assigned for a gas well. The AO for wells within a producing field is determined by the productive capacity of the reservoir and, if necessary, the spacing unit for the field.

All activities within an AO carried out in conjunction with an oil or gas well are approved and enforced by GS with surface protection input by the BLM area office.

Upon receiving approval to drill the proposed well, the operator moves construction equipment over existing roads to the point where the access road will begin. Generally the types of equipment include dozers (track- mounted and rubber-tired), scrapers, and motor-graders. The length of the access road varies from a few feet to several miles. Generally the shortest feasible route is selected to reduce the haul distance and construction costs.

The amount of level surface required for safely assembling and operating a drilling rig varies with the type of rig, but the average size is 300 feet by 350 feet. In addition to the drilling platform, a reserve pit is constructed, usually square or oblong, but sometimes in another shape to accommodate topography. The area disturbed for construction and the potential for successful revegetation depends largely on the steepness of the slope.

Usually drilling activities begin within a week or two after the location and access road have been constructed.

Drilling

Starting to drill is called "spudding in" the well. The initial drilling through shallow formations proceeds rapidly, and generally a string of surface casing is set before harder, deeper formations are encountered.

Drilling is accomplished by rotating a special bit under pressure. A combination of rotary motion and pressure causes rock to be chipped away at the bottom of the hole. Drilling mud is then circulated through the drill pipe to the bottom of the hole, through the bit, up the core of the well, through screen that separates the rock chips, and into a holding tank from which it is pumped back into the well. The mud is maintained at a specific weight and thickness to cool the bit, reduce the drag of the drill pipe on the sides of the well hole, seal off any porous formation, contain formation fluids to prevent a blowout or loss of drilling fluid, and bring the rock chips to the surface for disposal.

Drilling operations are continuous, 24 hours a day and seven days a week. Upon completion of the drilling, the equipment is removed to another location. The reserve pit is fenced. If oil or gas is not discovered in commercial quantities, the well is a dry hole. Rehabilitation of the drill site and access road is done in accordance with the stipulations attached to the approval of the well site by the BLM.

When an oil or gas discovery is made, the Wyoming State Oil and Gas Conservation Commission assigns well spacing for the field. In the Platte River Resource Area, spacing for oil wells varies from 10 to 690 acres per well. Spacing for gas is from 160 to 640 acres per well (as per Wyoming Oil and Gas Statistics 1979). An alternative spacing may be granted if the operator can show the different spacing is needed for maximum recovery, and if the state and federal agencies approve.

Development and Production

Wells are completed and production equipment is installed if it is determined that oil or gas is present in commercial quantities. If the formation pressure is sufficient to raise oil to the surface, the well is completed as a flowing well. If pressure is inadequate to raise the oil to the surface, the well is completed with a pump above or below the ground.

After an oil well has been placed in production, the unused portions of the drilling locations are reshaped, the reserve pits are backfilled after they are dry, the topsoil material is redistributed, waterbars and diversions are constructed to prevent erosion, and the area is reseeded.

In a flowing well, the reservoir pool tapped by a well eventually becomes depleted so that the well requires a pump. The majority of the productive wells drilled in the Platte River Resource Area require pumps. Surface pumps are powered by internal combustion engines or electric motors.

If produced oil contains water, it is separated before the oil is stored in a tank battery. The fluid is pumped or flows from the wellhead to a heater-treater through buried pipelines. Heat is applied to the heater-treater by the firebox (an integral part of the equipment) to break the emulsion. The heat is supplemented in most cases by chemicals. The oil is then pumped via pipeline to storage tanks, called the tank battery. However, if a well produces both oil and gas, provisions for shipping the gas must be made before oil production can continue.

Any gas occurring with the oil is separated by venting it out the top of the tank battery and into feeder lines leading to transportation lines. Oil is then transported to a refinery or to a truck depot, where it is unloaded into a pipeline leading to a large interstate pipeline.

Production equipment, including heater-treater, holding facility for production water (if any is present), and tank battery, is either placed on a portion of the location (on cut rather than fill) or located a short distance from the wellhead along the access road.

Excess water produced with the oil or as a result of water flooding must be disposed of. Although most produced waters are brackish to highly saline, some are fresh enough for beneficial use.

Fresh water is discharged into drainages and is eventually mixed with surface water. Surface owners and public land grazing lessees may obtain fresh water that is discharged from oil fields and use it for agricultural purposes. Water discharge must meet standards of, and be permitted by, the Wyoming Department of Environmental Quality. To aid in the purification of the water, oil skimmer pits are often established between the separating facilities and the surface discharge point.

Salt water is usually disposed of underground, often by introduction into a formation containing water of equal or poorer quality. In some fields, dry holes or depleted producing wells are used as disposal wells.

Abandonment and Rehabilitation

The depletion of an oil field is a gradual progression. Outlying wells are abandoned, and the field gets progressively smaller until the total original field is abandoned.

Abandonment procedures are similar for once-productive wells and dry holes. When the decision is made to "dry hole" a well, or to take it out of production, a concrete plug is installed at the bottom of the casing, the casing is filled with heavy mud, and a concrete cap is installed on top. In uncultivated areas, a marker pipe may be installed on top of the plugged drill pipe. Marker pipes extend 4 feet above ground and give the legal description of the site. The pumpjack, storage tanks, sheds, and anchors are removed. The concrete pad to which the pumpjack was attached is usually buried.

Upon abandonment, a well useful as a water producer may be acquired by the surface owner from the oil or gas operator. In this case, the well is plugged below the water-bearing formation and then completed as a water well.

Complete rehabilitation of the drill site is governed by the length of time it takes for the reserve or production pit to dry. The drying time depends on the soil texture and the amount of water remaining in the pit. After the pit is dry, the location is reshaped to approximately the original contour. For a dry hole location, this requires moving the soil material back uphill to its original position and redistributing the topsoil, then preparing the seed bed and seeding.

Access roads are reshaped and reseeded in a manner similar to that employed in reclaiming well locations, unless a private landowner requests that they be left in place.

Compliance inspections are periodically conducted by BLM to check the progress of the rehabilitation. Final abandonment is not approved until vegetation has been reestablished to the satisfaction of the BLM and the MMS. On privately owned surface, the landowner must be consulted concerning his satisfaction with the rehabilitated areas.

REGULATIONS AFFECTING OIL AND GAS ACTIVITY

Right-of-Way

A right-of-way permit is required for all off-lease facilities. This includes roads, pipelines, tanks, and heater-treaters. Right-of-way permits also are required for all third party activities on the lease.

An application with map and filing fee must be submitted to the appropriate BLM resource area office. Upon receipt of this information, the BLM will conduct an environmental assessment to determine if a major federal action is proposed; if so, an environmental impact statement is prepared. If the action is determined not to be a major federal action, stipulations to mitigate any associated impacts are attached to the right-of-way grant, and the applicant is given permission to proceed with right-of-way development.

Details of the methods and procedures for oil and gas activities are discussed in the "Detailed Account of Oil and Gas Actions" section of the *Buffalo Resource Area Programmatic Oil and Gas Environmental Assessment* (USDI, BLM 1980). This information also is covered in section 3109 of the *BLM Manual*.

MFP Decisions

Current MFP decisions pertaining to restrictions on oil and gas leasing in the PRA are listed below and summarized on the oil and gas stipulation map (see Maps 1 and 2, Appendix 9).

General Oil and Gas Leasing Restrictions

With the exception of terms relevant to the four areas mentioned earlier, the entire resource area will remain open to oil and gas leasing and exploration subject to the following restrictions unless waived by the district supervisor, MMS, with concurrence of the District Manager, BLM.

No occupancy or other surface disturbance will be allowed on slopes in excess of 25% without written permission from the district supervior, MMS, with the concurrence of the District Manager, BLM. When disturbance is proposed on slopes in excess of 15%, engineered drawings for construction, drainage design, and final contours proposed after rehabilitation will be required.

No surface disturbance will be permitted within ¼ mile of the North Platte River.

No surface disturbance will be permitted within 500 feet of streams, reservoirs, and canals.

No surface disturbance will be permitted within 200 feet of intermittent or ephemeral drainages.

No surface disturbance will be permitted within 200 feet of state and federal highways or county roads.

In order to minimize watershed damage, exploration, drilling, and other development activity will be allowed only from June 1 to December 30 on the following areas:

South Fork Powder River Drainage
Coal Mountain-Twin Buttes area
Pine Mountain
Rattlesnake Range
Holliday Draw
Badwater-Deadman Butte area
Pine Ridge
Bear Peak
Goshen Hole Rim area

From June 1 to November 30, development activity will be allowed in the following areas:

Muddy Mountain

The placement of lineal facilities will not be allowed in the following areas:

Highway 220, Bessemer Mountain to Alcova
Along I-25 in Townships 37, 38, 39, and 40 N., R. 79 and 80 W.
Rattlesnake Range
Pine Ridge and west to Edgerton
Red Wall and South Big Horn Mountains

No tree cutting will be allowed in wild turkey habitat as identified on overlays in the Casper District Office.

Surface occupancy is restricted from (*legal subdivision*) until it is determined that the action will not adversely affect the black-footed ferret or its critical habitat. Such determination will be made by a biological assessment by the BLM and/or by consultation with the USFWS under section 7 of the Endangered Species Act.

Minerals exploration and drilling, lands right-of-way actions, or other surface disturbances will not be allowed in critical winter range for antelope between November 1 and April 30 (see Map 2 in Appendix 9).

Minerals exploration, mining, lands right-of-way actions, or other surface disturbances will not be allowed in critical winter range for deer between November 1 and April 30 (see Map 2 in Appendix 9).

The BLM will designate nesting seasons and suitable buffer zones of no surface disturbance around active nests of raptors of high federal or state interest. Species identified jointly by the BLM and the U.S. Fish and Wildlife Service and by the Wyoming Game and Fish Department are bald eagle, golden eagle, osprey, peregrine falcon, prairie falcon, merlin, ferruginous hawk, and Cooper's hawk. An active nest is defined as one that has been used at least once during the previous three years. The size of the buffer zone and the season of nesting will be determined on a case-by-case basis by the BLM area biologist, who will consider topography and raptor prey habitat surrounding the nest site. Buffer zones for active eagle nests and for cliff nesting sites of falcons (including kestrel) will be determined in consultation with the U.S. Fish and Wildlife Service.

A seed mixture will be required that is based on native seed mixtures that have demonstrated success in the same field or in similar settings.

Temporary access road rehabilitation will be completed as per WSO Manual Supplement (Rel. 3-5, 9-2-76) to *BLM Manual* 3109, Appendix 4, pages 11-13 and Appendix 4B, illustration 7.

Drill pad rehabilitation as per WSO Supplement (Rel. 3-5, 9-2-76 to *BLM Manual* 3109, Appendix 7, pages 1-4, and illustration 9 (Appendix 4D) 10 and 11 (Appendix 7).

No surface occupancy or other surface disturbance will be permitted on parcels along Cottonwood Creek in T. 27 N., R. 70 W.

No surface occupany will be allowed within 600 feet of the Laramie River.

No surface occupancy or other disturbance will be permitted on Cedar Ridge.

All proposed actions that will disturb soil or vegetation or place a structure in the landscape will be evaluated for visual resource impacts in accordance with *BLM Manual* 6320. All phases of oil and gas development in visual resource management Class II areas must meet management standards for that class; that is, man-made changes should not be evident in the landscape. Specific plans for construction of roads and locations will be examined and suggestions offered by the PRA recreation planner.

Significant Cultural Resource Sites

No occupancy or other surface disturbance will be permitted on the following parcels along the Bozeman Trail (federal minerals):

> T. 40 N., R. 75 W., Sections 2, 11, 12, 13, 14, 24, 25; T. 39 N., R. 74 W., Sections 27, 28, 34, 35; T. 38 N., R. 74 W., Sections 2, 25, 26; T. 37 N., R. 74 W., Sections 18 and 23; T. 36 N., R. 74 W., Sections 10, 22; and T. 35 N., R. 73 W.

No occupany or other surface disturbance will be permitted within 200 feet of the Oregon Trail, Cheyenne-Black Hills Stage Route, Texas Trail, First Transcontinental Telegraph Line, and Mormon Trail.

No occupancy or other surface disturbance will be permitted on the following parcels of the Oregon Trail in Natrona County:

> T. 30 N., R. 85 W., Section 15, SE¼NW¼; T. 31 N., R. 84 W. Section 21, SE¼SE¼, Section 28, NE¼; T., 31 N., R. 83 W., Section 1, NW¼NW¼, Section 2, NE¼NE¼, Section 3, S½S½, NE¼SE¼, Section 4, SE¼SE¼, Section 8, SE¼SW¼, SW¼SE¼, Section 9, NE¼NE¼, Section 17, NW¼, Section 18, S½NE¼, N½SE¼, W½SW¼, SW¼SW¼.

No occupancy or other surface disturbance will be permitted on the following parcels in the Spanish diggings (federal minerals):

> T. 30 N., R. 67 W., Sections 1, 2; and T. 31 N., R. 67 W., Section 35.

No occupany or other surface disturbance will be permitted within the boundaries of the Fort Fetterman Historic Site.

No surface occupancy or other surface disturbance will be permitted on the following Casper School District Environmental Education Areas:

> T. 33 N., R. 80 W., Section 15, S½NW¼, NW¼SE¼; T. 34 N., R. 78 W., Section 25, E½NE¼, Section 26, SE¼SW¼.

Special Management Areas

No leasing will be permitted on the following parcels. These parcels have been removed from leasing because of resource considerations and the inability to adequately reclaim them:

> T. 31 N., R. 83 W., Section 25, W½NW¼, Section 26, E½E½, SW¼NE¼, W½, W½SE¼; T. 39 N., R. 80 W., Section 20, S½NE¼, E½SE¼, S½NW¼, N½SW¼, W½SE¼, SE¼SW¼, Section 21, N½, N½S½, S½SE¼, SE¼SW¼, Section 28, NW¼NW¼, SW¼NE¼; T. 40 N., R. 77 W., Section 15, S½SW¼, Section 22, E½NE¼, SE¼NW¼.

Public lands in critical winter range for elk (areas E-1, E-2, E-3, and E-4) will be managed primarily for elk, with the following limitations placed on other users:

Sufficient forage will be allocated to support wintering elk; no minerals exploration or mining will be allowed; no lands rights-of- way or land disposal actions will be permitted; there will be no ORV or snowmobile use from November 1 through April 30; and other winter recreation will be limited by not improving winter access.

The Red Wall and Jackson Canyon and pterodactyl tract ACECs will be excluded from minerals exploration and mining, as will activities under the General Mining Law of 1872. Also excluded will be lands rights-of- way, dispersal actions, and any other surface disturbance.

Baldy Ridge, Baldy Peak, and Squaw Mountain are withdrawn from public land laws, general mining laws, the Mining Law of 1872, and ORV use.

No occupancy or other surface disturbance will be allowed within the rims of the following canyons and gorges (see Map 1 in Appendix 9): Deer Creek Canyon, Boxelder Creek Canyon, Rock Creek Canyon, Wagonhound Gorge, Brighton Canyon, Eagles Nest Canyon, and Goshen Hole Rim.

No occupancy or other surface disturbance will be permitted on the following parcels that adjoin the North Platte River: T. 34 N., R. 76 W., Section 31, SW¼, Section 34, SE¼SE¼; T. 33 N., R. 74 W., Section 2, SW¼SW¼; T. 31 N., R. 71 W., Section 5, NE¼SE¼; Section 23, NE¼NW¼.

No occupancy or other surface disturbance will be permitted on the following Wildlife Habitat Management areas: Table Mountain Wildlife Area, Bump-Sullivan Reservoir Area, Springer Reservoir Area, and Golden Eye Wildlife and Recreation Area.

Utility Corridors

Because of increasing mineral activity in the Powder River basin, a corridor study with recommendations for Converse County was prepared in 1977. The MFP decision was to accept the recommendations of the study for the entire resource area.

Rights-of-way proposed for utility corridor systems include pipelines 6 inches in diameter or larger, electric power lines with an "H" type structure or larger, major collector highways, and all main railroad lines leading out of the resource area.

In effect, this recommendation would establish corridors around existing facilities. New corridors would be considered only when location within a compatible distance of existing facilities could be demonstrated to be impractical and unfeasible and where the environmental impact could be mitigated. A compatible distance will be determined on a case-by-case basis considering minimum design standards for the system considered and major impacts to the human environment.

The following corridors have been identified:

Between I-25 and North Platte River, as close as possible to highway

U.S. 87, except the Edgerton-Midwest Area

I-25 east of Casper and north to the Teapot VABM

Highway 26 west of Casper, 1 to 3 mile width

State Highway 387, excluding the segments from the U.S. 87 junction to 3 miles northwest of Edgerton

Poison Spider Road—1 to 2 mile width

Oregon Trail Road—1 to 2 mile width, avoiding parcels previously identified for no surface occupancy

Bureau of Reclamation boundaries north of the North Platte River—electrical lines only

Early in the planning stages of mineral exploration and development, the cooperation and input of the landowner will be sought for plans for the protection or restoration of watershed values. Cooperation should also be sought from the GS and the oil field operator.

Where specific reclamation stipulations were not included in the original lease, cooperation will be sought from the GS, the oil field operator, and the landowner for development of reclamation plans on federal minerals.

The following stipulations will be appied to leases in the Laramie Peak Range in Natrona, Converse, and Platte counties.

Road and drill pad construction in stands of trees and mountain browse (mountain mahogany, bitterbrush, serviceberry) will be avoided. If there is no possibility of placing a road or drill pad away from these stands of trees and brush, then when possible seedlings of the species disturbed should be planted in a density comparable to that in the adjacent undisturbed stand.

When exploration is completed and no petroleum is found, or when a field is abandoned, all roads will be recontoured and reseeded with a mixture of grass and forbs and, as appropriate, shrubs and/or trees. All abandoned roads will be barricaded and made unsuitable for vehicular travel at the discretion of the area manager.

Stipulations for Leases

The following standard stipulations may be applied to leases in the Casper District on a case-by-case basis to deal with specific situations. Where blanks appear, specific numbers, dates, or descriptions will be inserted to suit the particular circumstances.

1. All of the land in this lease is included in (*recreation or special area, etc.*). Therefore, no occupancy or disturbance of the surface of the land described in this lease is authorized. The lessee, however, may exploit the oil and gas resources in this lease by directional drilling from sites outside this lease. If a proposed drilling site lies on land administered by the Bureau of Land Management, a permit for use of the site must be obtained from the BLM District Manager before drilling or other development begins.

2. No access or work trail or road, earth cut or fill, structure or other improvement, other than an active drilling rig, will be permitted if it can be viewed from the (*road, lake, river, etc.*).

3. No occupancy or other activity on the surface of (*legal subdivision*) is allowed under this lease.

4. No occupacny or other surface disturbance will be allowed within ___ feet of the _____ (*road, trail, river, creek, canal, etc.*). This distance may be modified when specifically approved in writing by the District Engineer, Geological Survey, with the concurrence of the District Manager, Bureau of Land Management.

5. No drilling or storage facilities will be allowed within ___ feet of (*live water, the reservoir, etc.*) located in (*legal subdivision*). This distance may be modified when specifically approved in writing by the District Engineer, Geological Survey, with the concurrence of the District Manager, Bureau of Land Management.

6. No occupancy or other surface disturbance will be allowed on slopes in excess of ___ percent, without written permission from the District Engineer, Geological Survey, with the concurrence of the District Manager, Bureau of Land Management.

7. In order to (*minimize watershed damage, protect important seasonal wildlife habitat, etc.*), exploration, drilling, and other development activity will be allowed only during the period from __ to __. This limitation does not apply to maintenance and operation of producing wells. Exceptions to this limitation in any year may be specifically authorized in writing by the District Engineer, Geological Survey, with the concurrence of the District Manager, Bureau of Land Management.

8. In order to minimize watershed damage during muddy and/or wet periods, the District Manager, Bureau of Land Management, through the District Engineer, Geological Survey, may prohibit exploration, drilling, or other development. This limitation does not apply to maintenance and operation of producing wells.

9. The _____ (*trail/road*) will not be used as an access road for activities on this lease.

10. To maintain esthetic values, all semi-permanent and permanent facilities may require painting or camouflage to blend in with the natural surroundings. The paint selection or method of camouflage will be subject to approval by the District Engineer, Geological Survey, with the concurrence of the District Manager, Bureau of Land Management.

11. No occupancy or other surface disturbance will be allowed within a 1,320-foot radius of the center of a sage grouse strutting ground (lek). No exceptions to this will be granted. In order to protect the nesting area around the strutting ground, exploration, drilling, and other development activity will be allowed within a 1¾ mile distance from the ¼-mile lek protection zone only during the period June 15 to March 1. Exceptions to the monthly limitations in any year may be specifically authorized in writing by the District Engineer, Geological Survey, with the concurrence of the District Manager, Bureau of Land Management.

12. Cultural Resource Stipulation 1: The lessee will not disturb the surface of the lease until a cultural resource investigation has been conducted by the BLM or a professional acceptable to the BLM for the specific area on which surface disturbing activity is planned. The results of this investigation will be submitted to the BLM State Director and the BLM will provide stipulation for avoidance or salvage of any significant cultural resources. The cost of all investigations and salvage will be borne by the lessee.

Cultural Resource Stipulation 2: The cultural resource investigation on this lease/permit/right-of-way indicated that buried cultural values may be present. However, surface condition of vegetation, snow, or alluvium prevented an adequate evaluation of these cultural resource values. To protect and evaluate these values the permittee/lessee/grantee will engage a professional acceptable to the BLM to observe surface disturbance through specific area as given, Section___, Township___North, Range___ West, and a report submitted to BLM District Manager within 30 days of completion of the project. If significant values are observed they will be left intact and the BLM District Manager notified to conduct an evaluation to establish suitable salvage.

Cultural Resource Stipulation 3: If any cultural values are observed during operation on this lease/permit/right-of-way, they will be left intact and the BLM District Manager notified. The district manager will conduct an evaluation of the cultural values to establish suitable mitigation or salvage.

The standard wilderness protection stipulation will not be used in this resource area, which contains no wilderness areas and no areas under study for possible wilderness designation.

Legal Restrictions

Prohibition of leasing in certain areas is discussed under "Law and Policy" in chapter 1.

Standard lease stipulations and other pertinent information relating to oil and gas leasing and development may be found in the Wyoming State Office supplement to Section 3109 of the *BLM Manual*, "Surface Management Requirements for Oil and Gas Operations." See standard lease stipulations.

"Surface Operating Standards for Oil and Gas Exploration and Development," second edition, prepared by the BLM, the GS, and the FS, discusses permit requirements, reclamation standards, and road standards. Other laws and enforcing agencies are identified in Appendix 1.

ALTERNATIVE 2

Alternative 2, Leasing with Special Stipulations, would add further stipulations to leases to mitigate environmental impacts described in chapter 4.

These impacts would result from oil and gas development under the proposed action if no further resource protection were provided than that called for in standard stipulations and existing MFP decisions relevant to protection of the resource.

The only stipulations analyzed under this alternative were new ones; that is, those providing protection not already available through the use of existing stipulations, policies, or decisions. This alternative also provides for identification of areas where restrictions on oil and gas leasing should be increased or decreased, depending on resource values present. The following special stipulations apply to this alternative:

Soils Stipulations

1. Snow and ice will not be mixed with subsoil material used in the construction of roads, well locations, reserve pit dikes, etc.

Development, rights-of-way: This stipulation is intended to eliminate the mixing of snow and ice with subsoil that is to be used in the construction of the reserve pit dike, well pads, and roads. The stipulation would improve the operator's capability to pack the dike, reduce the potential of leaking, and minimize the potential for subsidence in roads and well locations.

Wildlife Stipulations

1. The "no surface occupancy" or "no lease" stipulation will be applied to elk critical winter range and to bald eagle winter range (shown on map 2 in Appendix 9) on the basis of Wyoming Supplement 3109, Surface Management Requirements for Oil and Gas Operations, Appendix 2, pages 3, 4, and 5.

Development: This measure would protect elk and their habitat and bald ealges and their habitat during the critical winter season. To prevent producing oil fields from operating in this habitat during winter, surface occupancy must be prohibited year round.

2. Tree disturbance will not be permitted in critical winter habitat for turkeys. When tree disturbance is necessary in other turkey habitat, trees will be replaced by the same species at a ratio of 1.5:1 new trees to removed trees (see map 2 in Appendix 9).

Leasing and Development, rights-of-way: This stipulation would protect existing turkey habitat from significant disturbance.

Cultural Resources Stipulations

1. The "no surface occupancy" stipulation will be rescinded on the following parcels of land: T. 31 N., R. 83 W., Sec. 3, S½S½, NE¼SE¼, Sec. 4, SE¼SE¼, and Sec. 9, NE¼NE¼. Previously identified cultural resources have been found, upon Class III review, to be nonexistent.

Geophysical exploration, leasing and development, rights-of-way: This would permit all phases of oil and gas activity on the parcels identified.

Stipulations for Residental Areas

1. No trash will be buried at the well site. Trash will be confined in a covered container and removed by the operator to an approved landfill periodically, or incinerated in a DEQ approved incinerator on the location.

Development, rights-of-way: This stipulation would protect local residents from windblown debris and also would protect against subsidence of the trash pit after the drilling operation was completed.

2. Any unincorporated subdivision road used for development and production activities will be maintained at the original condition, or better. New access roads will be located as far as reasonably possible from existing occupied dwellings. (In incorporated subdivisions, the company will meet city standards.)

Development, rights-of-way: This stipulation would reduce the safety hazard to subdivision residents and other persons using the roads. Such hazards might otherwise result from road deterioration.

3. The operator will equip the engines powering a drilling rig within ___ mile of a dwelling with mufflers that prevent noise levels exceeding 86 dB when measured 50 feet away from the source. Exhaust pipes will be directed away from dwellings within ___ mile.

Development: This stipulation would protect subdivision residents or ranchers from loud engine noise during quiet periods of the day (such as at night).

4. The operator will erect a fence 6 feet high of not larger than 4-inch mesh around the entire drilling location and reserve pit during drilling. The fence must remain until the drilling equipment is taken away from the area and the reserve pit is closed, if the location is nearer than ___ mile to a dwelling. If the well is a producer, the facilities must be fenced for the life of the well.

Development: This would protect children, pets, or others from getting into the operating area and possibly being injured.

5. The operator will remove the contents of any reserve pit within ___ mile of a dwelling to an approved disposal area within 30 days after drilling is complete, and all excavations will be closed.

Development: This precaution would protect local residents and unsuspecting individuals and animals from possible injury.

6. The operator will not place storage tank batteries or heater-treaters within ___ feet of any dwellings unless they are placed in a camouflage structure acceptable to local conditions.

Development: This stipulation would protect local residents from intrusions on their landscape and also protect them from the hazards associated with heater-treaters and tank batteries.

7. All pumps and production units in subdivisions will be powered by electric motors and have a noise level no higher than 86 dB when measured 50 feet from the source. Pumps and production units within ___ mile of ranch dwellings must be similarly muffled and the exhaust pipes directed away from the dwellings.

Development: This would protect local residents from the loud engine noises of gas-powered pump engines.

Recreation Stipulations

1. Near recreation areas, the operator will equip engines powering pumpjacks with mufflers that prevent noise levels exceeding 86 decibels when measured 50 feet away from the source. (Ex-

haust pipes will be directed away from these areas within ___ mile.)

Development: This stipulation will reduce the noise level around recreation sites.

AUTHORIZING ACTIONS

A widespread misconception exists that the BLM is the sole regulator of oil and gas operations on public land. This is not the case, as state and other federal agencies have a substantial role in regulating oil and gas activities. The roles of the BLM and the GS are discussed in the Introduction. Other federal agencies' responsibilities are as follows:

Fish and Wildlife Service (FWS)

Coordination and consultation are required between the BLM and the Fish and Wildlife Service in the following environmental circumstances:

1. Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.): When a proposed or carried out action would or could involve any stream or body of water and affect a fish and wildlife resource.
2. Bald and Golden Eagle Act of 1969 (16 U.S.C. 668-668c): When a proposed or carried out action would or could involve an eagle, its nest, and (or) its habitat.
3. Endangered Species Act (16 U.S.C. Sec. 1531): When a proposed or carried out action would or could involve an endangered/threatened species and (or) its habitat.

Advisory Council on Historic Preservation (ACHP)

Section 106 of the National Historic Preservation Act of 1966 as amended (16 U.S.C. Sec. 470 et seq.) requires that the President's advisory council have an opportunity to comment on any undertaking that could affect cultural resources on, or eligible for inclusion on, the National Register of Historic Places.

Executive Order 11593, "Protection and Enhancement of the Cultural Environment," mandates that all Executive Branch agencies, bureaus, and offices, (1) compile an inventory of the cultural resources for which they are trustees, (2) nominate all eligible government properties for inclusion on the National Register of Historic Places, (3) preserve and protect the cultural resources for which they are trustees, and (4) ensure that agency activities contribute to the preservation and protection of non-federally owned cultural resources. The council implements these regulations through procedures outlned in 36 CFR 800, "Protection of Historic and Cultural Properties."

BLM requires a cultural inventory prior to making a decision on any of the various rights-of-way and temporary use applications that involve surface disturbing activities on federal land, to ensure compliance with the National Historic Preservation Act. Consultation will be made with the State Historic Preservation Officer as applicable.

Environmental Protection Agency (EPA)

The EPA has issued regulations affecting all oil and gas lessees and operators (40 CFR 112). These regulations require owners or operators to prepare spill prevention control and countermeasure (SPCC) plans. EPA does not make special inspections to see that operators have SPCC plans; however, the agency can request one from an operator. An operator who does not provide the SPCC plan is subject to a fine. After a hazardous material spill occurs, EPA usually calls for the operator's SPCC plan.

The following agencies of the state of Wyoming also have a role in regulating oil and gas activity:

Wyoming Department of Environmental Quality (DEQ)

DEQ has authority relating to air quality, solid wastes, and water quality. The Land Quality Division responsibilities include permits and reclamation for material sales on state lands such as fill, sand, and gravel. The Air Quality Division issues permits to construct and permits to operate after approval of applications with regard to plans for monitoring and controlling air contaminants. The Water Quality Division issues permits to construct settling ponds and waste water systems, including ground water injection and disposal wells. It also regulates the disposal of drilling fluids from abandoned reserve pits and issues National Pollutant Discharge Elimination System permits for discharging waste water. The Solid Waste Division issues construction fill permits and industrial waste facility permits for solid waste disposal during construction and operation of facilities.

Wyoming Oil and Gas Conservation Commission

Oil and gas operators are required to receive permission to drill from the Oil and Gas Conservation Commission prior to operation. The commission controls well spacing in cooperation with GS, and it has the final authority on well location variance. The commission approves unit agreements and controls water and gas injection systems and underground gas storage projects. It also regulates the flaring and venting of natural gas.

Wyoming Commissioner of Public Lands

The Wyoming Commissioner of Public Lands issues oil and gas leases on state lands. The commissioner also issues easements for facilities crossing state lands.

State Historic Preservation Officer (SHPO)

The state liaison officer for the Advisory Council on Historic Preservation is consulted for compliance with Section 106 of the Historic Preservation Act of 1966. If an undertaking would cause damage or change in the quality or the character of a site, the Council and SHPO will consult with the agency on ways to remove or mitigate the effect.

State Highway Department

The Wyoming State Highway Department issues state "Permits to Access" for all proposed roads that connect onto Highway Department rights-of-way on state and U.S. highways. Permits for oversized and overweight loads are required for trucks using Wyoming highways.

State Engineer

The State Engineer's Office issues water permits for use of surface or subsurface water.

CHAPTER 3: THE AFFECTED ENVIRONMENT

INTRODUCTION

The detail of description for each resource in this chapter depends on the amount of impact expected on that resource.

Analysis of wild and scenic rivers, wilderness values, and unique and prime farmlands is mandatory. No rivers in the PRA have been designated or recommended for designation as wild and scenic rivers, and no wilderness values were found in the area in the wilderness review process that was completed for the resource area in 1979.

There are no unique farmlands in the PRA. The SCS has identified isolated small tracts of prime farmlands, but the inventory is not yet complete. More information is available from the SCS.

The resource area contains two areas of critical environmental concern (see Map 1). The Jackson Canyon Bald Eagle Roost ACEC on the west face of Casper Mountain is one of the largest wintering concentration areas in the Rocky Mountains for this endangered species. It is discussed further in the "Wildlife" section of this chapter. The Alcova Pterodactyl Tracks ACEC on the east side of Alcova Reservoir is discussed in the "Recreation" section. That area is subject to oil and gas leasing with a "no surface occupancy" stipulation.

In the category of floodplains and wetlands, the unit resource analysis (URA III) documents of the Natrona, Converse, and Lower Platte units discuss 122 streams and 16 reservoirs that contain fisheries. Floodplains in all risk areas in the PRA have been mapped by the Water Resources Division of the GS. Acreages have not been tabulated; however, maps are available at the Casper office of the GS Water Resources Division.

PHYSICAL RESOURCES

MINERAL RESOURCES

Occurrences

Minerals occurring in the Platte River Resource Area include oil and gas, chromium, copper, tungsten, coal, iron, vermiculite, bentonite, uranium, clinker, flagstone, moss rock, sand and gravel, and limestone. (Wyoming Geological Survey 1966, 1972, 1980). Only sand and gravel, clinker, bentonite, and oil and gas are affected by the oil and gas leasing program.

Clinker, sand, and gravel provide surfacing materials for roads, drill sites, and production facilities. About 250,000 cubic yards of these materials are used each year for maintenance and construction purposes associated with oil and gas activities. Major sources are usually adjacent to large drainages such as the Platte River. Large gravel deposits can be found in all Tertiary formations, and older formations composed chiefly of sandstone and conglomerate are potential sources of aggregate materials.

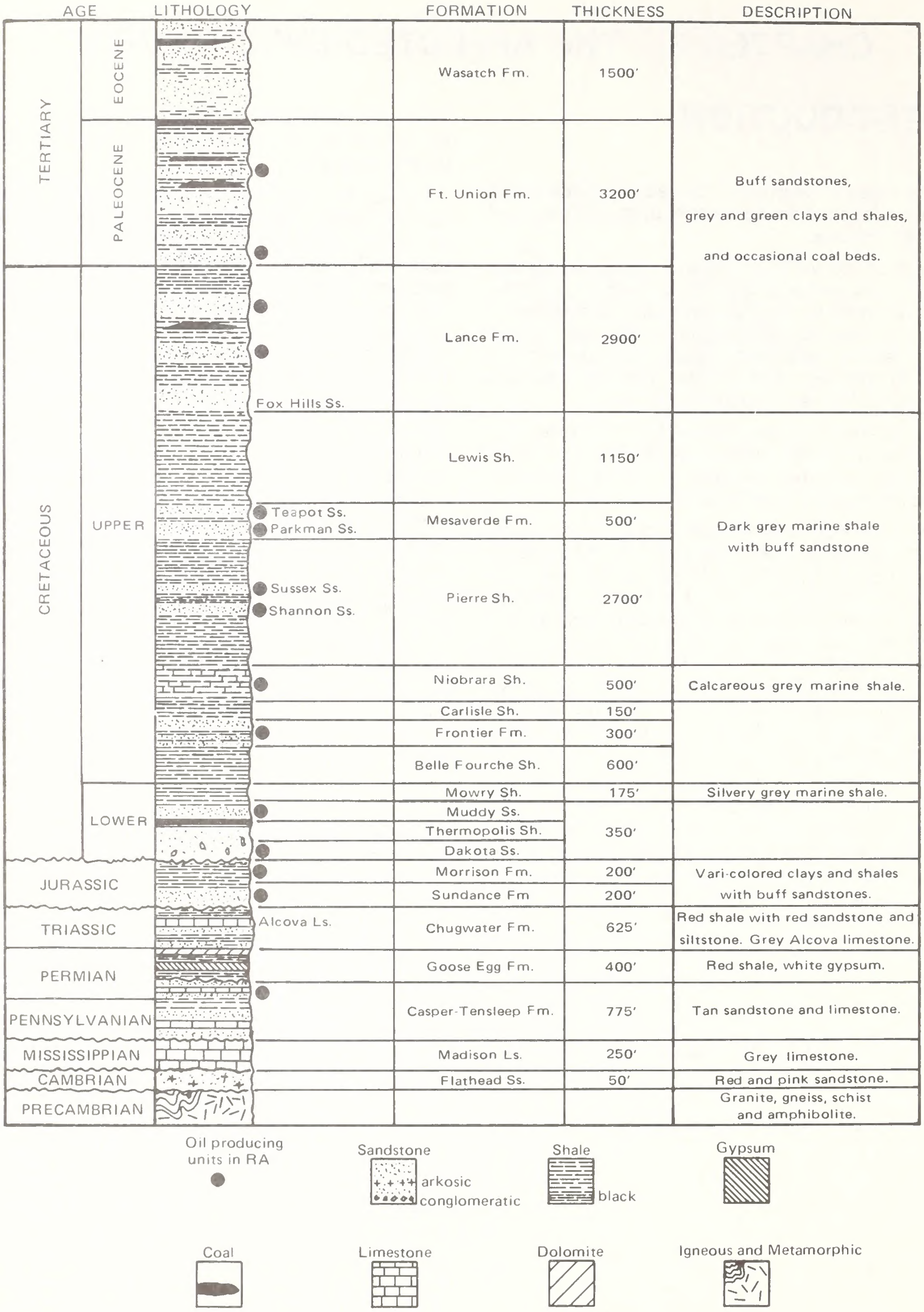
Bentonite is used in drilling muds associated with oil and gas exploration activities. The average well drilled to 8,500 feet will utilize over 26 tons of bentonite. Total bentonite usage in the PRA is estimated to be about 5,300 tons annually. Bentonite is present in the Mowry, Niobrara, and lower Pierre Shale formations, which outcrop in Natrona County along the southern part of the Big Horn Mountains.

The interrelationship between oil and gas activities and these commodities is not considered to be significant for the purpose of the present analysis and will not be discussed further. The rest of this section will deal exclusively with the oil and gas mineral resource.

Current and Potential Oil and Gas Development

Formations that have potential for containing oil and gas in the PRA are indicated in figure 3-1. While the production of petroleum has been decreasing statewide over the past few years, petroleum production in the resource area has increased (Wyoming Department of Economic Planning and Development 1981). Analysis of geologic cross-sections and maps covering such areas as the Rattlesnake Range, the south Big Horns, the Laramie Range, and the Hartville Uplift and a comparison with figure 3-1 suggest several possibilities for the discovery of new accumulations of petroleum (Morris and Babcock 1960; Rapp, Visher, and Littleton 1957; Love, Weitz, and Hose 1955; Pekarek 1978; Wyo. GS 1972, 1980).

A more detailed assessment of oil and gas potential is difficult because detailed information is not readily available. Figure 3-1 indicates that oil and gas could be found throughout most of the stratigraphic section. Precambrian rocks exhibit very low



AGE		LITHOLOGY	FORMATION	THICKNESS	DESCRIPTION
TERTIARY	EOCENE		Wasatch Fm.	1500′	Buff sandstones, grey and green clays and shales, and occasional coal beds.
	PALEOCENE	● ●	Ft. Union Fm.	3200′	
CRETACEOUS	UPPER	● ● Fox Hills Ss.	Lance Fm.	2900′	
			Lewis Sh.	1150′	Dark grey marine shale with buff sandstone
		● Teapot Ss. ● Parkman Ss.	Mesaverde Fm.	500′	
		● Sussex Ss. ● Shannon Ss.	Pierre Sh.	2700′	
		●	Niobrara Sh.	500′	Calcareous grey marine shale.
			Carlisle Sh.	150′	
		●	Frontier Fm.	300′	
			Belle Fourche Sh.	600′	
	LOWER		Mowry Sh.	175′	Silvery grey marine shale.
		●	Muddy Ss.	350′	
			Thermopolis Sh.		
		●	Dakota Ss.		
JURASSIC		●	Morrison Fm.	200′	Vari-colored clays and shales with buff sandstones.
		●	Sundance Fm	200′	
TRIASSIC		Alcova Ls.	Chugwater Fm.	625′	Red shale with red sandstone and siltstone. Grey Alcova limestone.
PERMIAN			Goose Egg Fm.	400′	Red shale, white gypsum.
PENNSYLVANIAN		●	Casper-Tensleep Fm.	775′	Tan sandstone and limestone.
MISSISSIPPIAN			Madison Ls.	250′	Grey limestone.
CAMBRIAN			Flathead Ss.	50′	Red and pink sandstone.
PRECAMBRIAN					Granite, gneiss, schist and amphibolite.

(Wyoming Geological Survey, 1972;1980 and Schwarber, 1959)

Figure 3-1
Geologic Column

potential, although petroleum has been found in Precambrian rocks. Rock formations of Cambrian through Mississippian age are considered to be of low potential, but again petroleum accumulations have been discovered in rocks of this age in southeastern Montana, and various articles in oil and gas trade journals have advocated more extensive exploration of these deeper stratigraphic horizons.

Lands adjacent to the synclinal axes of the Denver-Julesburg and Powder River basins also are thought to have low potential for oil and gas accumulation (see the "Minerals" section of the Lower Platte URA). The PRA lands described above as having very low potential or low potential for oil and gas discovery comprise about 493,800 acres of a total of 231,000 acres of federal mineral estate. The other 3,737,200 acres in the resource area are considered to have good potential for oil and gas discovery.

There are several producing fields along the north side of the Rattlesnake Range. Producing fields involving many types of traps also are common on the east and west sides of the Powder River basin synclinal axis in Natrona and Converse counties.

Nearly all petroleum production in the Denver-Julesburg Basin is on the east side of the synclinal axis. Production on the west side of the axis is confined to Laramie County, which is south of the PRA. It is difficult to know why there are no producing fields on the west side of the axis in Platte County, but part of the reason may be that well density is not sufficient to provide good information. Since potential producing formations generally are covered with younger Tertiary formation, so that interpretation of subsurface geology is difficult and expensive, those seeking oil and gas may be bypassing western Platte County in favor of "hunting grounds" with potential for which information is already available.

The *Western Oil Reporter* of July 1981 labeled as the "find of the year" a recent gas discovery in sedimentary rock under Precambrian rock in northwestern Natrona County (p. 60). The publication said the discovery resulted from "the first commercially successful exploratory test of sedimentary rocks beneath a mountain front thrust." This situation is shown in figure 3-2, row 1, column 3. Similar geologic situations are known to exist in the Badwater area in northwestern Natrona County and along the Laramie Range south of Glenrock in Converse County. The potential for such discoveries has been known for many years, but only a few tests have been made. Now that significant reserves have been found, more activity can be expected in that area and several other thrust areas in the region. The subthrust discovery has resulted in much additional leasing along the front of the Laramie Mountain Range, Rattlesnake Mountain, the South Big Horn Mountains, and in the mountains around Glendo Reservoir. This includes acreage that has never been leased for oil and gas before.

It seems reasonable to theorize that unexplored parts of the resource area may contain significant undiscovered petroleum reserves. The oil and gas industry is becoming more adept at finding small fields even though the probability of finding one decreases with time. Most remaining reserves are believed to be trapped in small fields that cover about ½ square mile each and an average of 300,000 barrels of oil or equivalent gas.

CLIMATE

The overall climate of the area influences resources such as air quality, soils, and vegetation, and hence the degree of impact resulting from oil and gas activity on the resources. Factors important to the understanding of climatic influences on other resources are discussed in their respective sections. A detailed description of the climate in the PRA can be found in the Step II URA documents for the Natrona, Converse, and Lower Platte planning units (USDI, BLM 1976, 1977, and 1976, respectively).

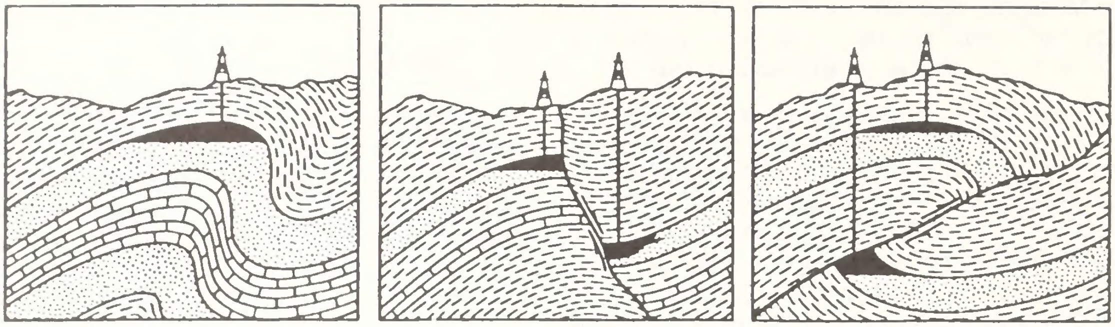
AIR QUALITY

The air quality in the PRA is described in *Final Report Baseline Climate and Air Quality for BLM Lands in Wyoming* (Science Applications, Inc. 1980).

Air quality in the PRA is within the federal and state air quality standards in most cases (see tables 3-1 through 3-4). The long-term trend of the air quality in most places is toward improvement. Air quality degradation, primarily in the form of suspended particulates, is most noticeable in localized areas near major populaiton centers. See table 3-5 and map 3-1 for locations of point sources emitting 100 or more tons of pollutants per year on a continuing basis. Map 3-2 shows locations of Wyoming DEQ air quality monitoring stations.

Sulfur dioxide (SO_2) data shows that amounts throughout the state were equal to or less than the long-term mean, possibly indicating a downward trend in SO_2 (Science Applications, Inc. 1980). Ni-

Structural



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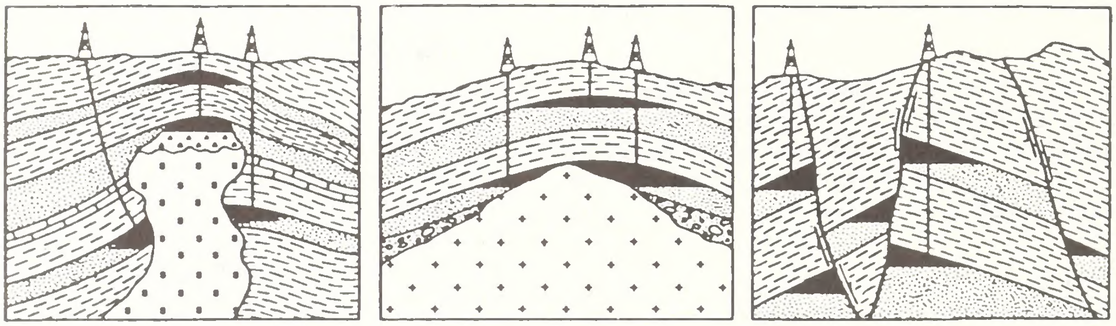
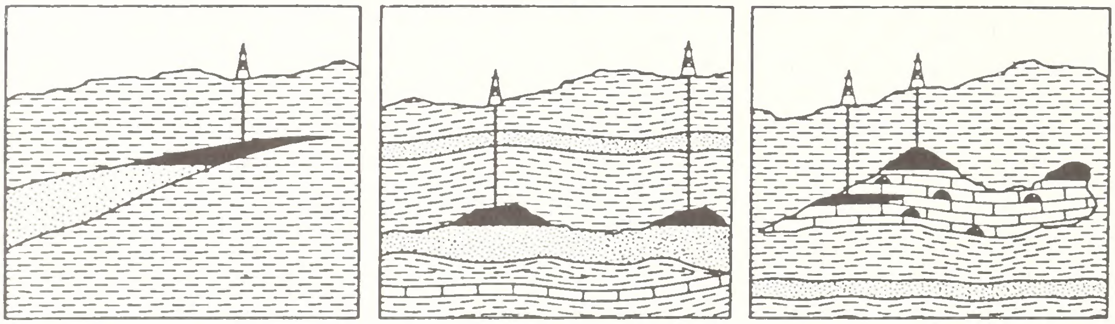
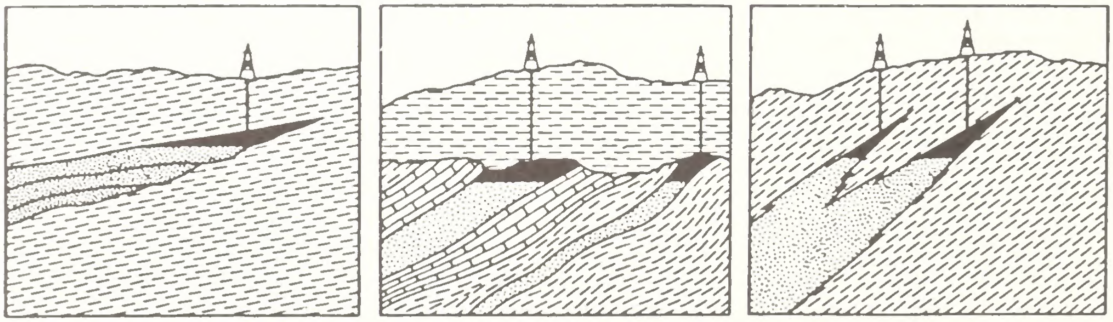


Stratigraphic



Strati-structural



Examples of several types of structural, stratigraphic, and stratistructural entrapment conditions for oil and gas. To obtain the overall picture, the third dimension must be evaluated from contour maps, multiple cross sections, and geophysical data. (Source: L.W. LeRoy, 1977).

Figure 3-2
Geologic Traps

TABLE 3-1
FEDERAL AND WYOMING AIR QUALITY STANDARDS

Pollutant	Averaging Time	Federal Primary Standards #1		Federal Secondary Standards #2		Wyoming State Standards **	
		mcg/m^3	ppm	mcg/m^3	ppm	mcg/m^3	ppm
Sulfur dioxide (SO_2)	Annual arithmetic	80	0.03			60	0.02
	24-Hour	365	0.14			260	0.10
	3-Hour			1,300	0.5	1,300	0.5
Total suspended particulates (TSP)	Annual geometric	75		60		60	
	24-Hour	260		150		150	
Nitrogen dioxide (NO_2)	Annual	100	0.05	100	0.05	100	0.05

#1 40CFR50, National Ambient Air Quality Standards (standards for averaging time of less than one year are not to be exceeded more than once a year). The Environmental Protection Agency (EPA) set primary and secondary National Ambient Air Quality Standards (NAAQS) in April 1971. The primary standards were established to protect human health, whereas the secondary standards were established to protect the public welfare from any known or anticipated adverse effect.

#2 Wyoming Ambient Air Quality Regulations, as amended in 1975 (standards for averaging times of less than one year are not to be exceeded more than once a year).

TABLE 3-2
AIR QUALITY DATA FOR THE PLATTE RIVER RESOURCE AREA SEASONAL AND ANNUAL ARITHMETIC MEANS AND MAXIMUM VALUES mcg/1m^3 OF TOTAL SUSPENDED PARTICULATES

(1978)

Monitor Location	Winter		Spring		Summer		Fall		Annual	
	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.
Casper City	63	150	116	179	NA	NA	56	71	73	179
Burk Ranch	19	34	18	29	36	53	NA	NA	22	53
Douglas (North)	10	28	12	35	20	68	26	35	17	68
Irene Ranch	13	27	25	87	26	48	36	118	25	118
Lingle	13	29	27	77	33	68	42	119	29	119
Wheatland (North)	17	28	9	24	16	26	19	31	14	31
Torrington	22	43	27	62	39	64	NA	NA	27	64
Bill (Newcastle)	10	20	17	46	23	39	NA	NA	16	46
Wheatland (City Center)	25	74	49	194	45	63	54	96	44	194

Science Applications, Inc. 1980

TABLE 3-3
AIR QUALITY DATA FOR THE PLATTE RIVER RESOURCE AREA SEASONAL AND ANNUAL ARITHMETIC MEANS AND MAXIMUM VALUES mcg/1m^3 OF NITROGEN DIOXIDE

(1978)

Monitor Location	Winter		Spring		Summer		Fall		Annual	
	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.
Casper City	22	47	28	48	NA	NA	31	62	26	62
Irene Ranch	2	8	6	10	5	8	2	5	4	10
Wheatland	6	15	6	11	4	8	5	8	5	15

Science Applications, Inc. 1980

TABLE 3-4
AIR QUALITY DATA FOR THE PLATTE RIVER RESOURCE AREA SEASONAL AND ANNUAL ARITHMETIC MEANS AND MAXIMUM VALUES mcg/1m^3 OF SULFUR DIOXIDE

(1978)

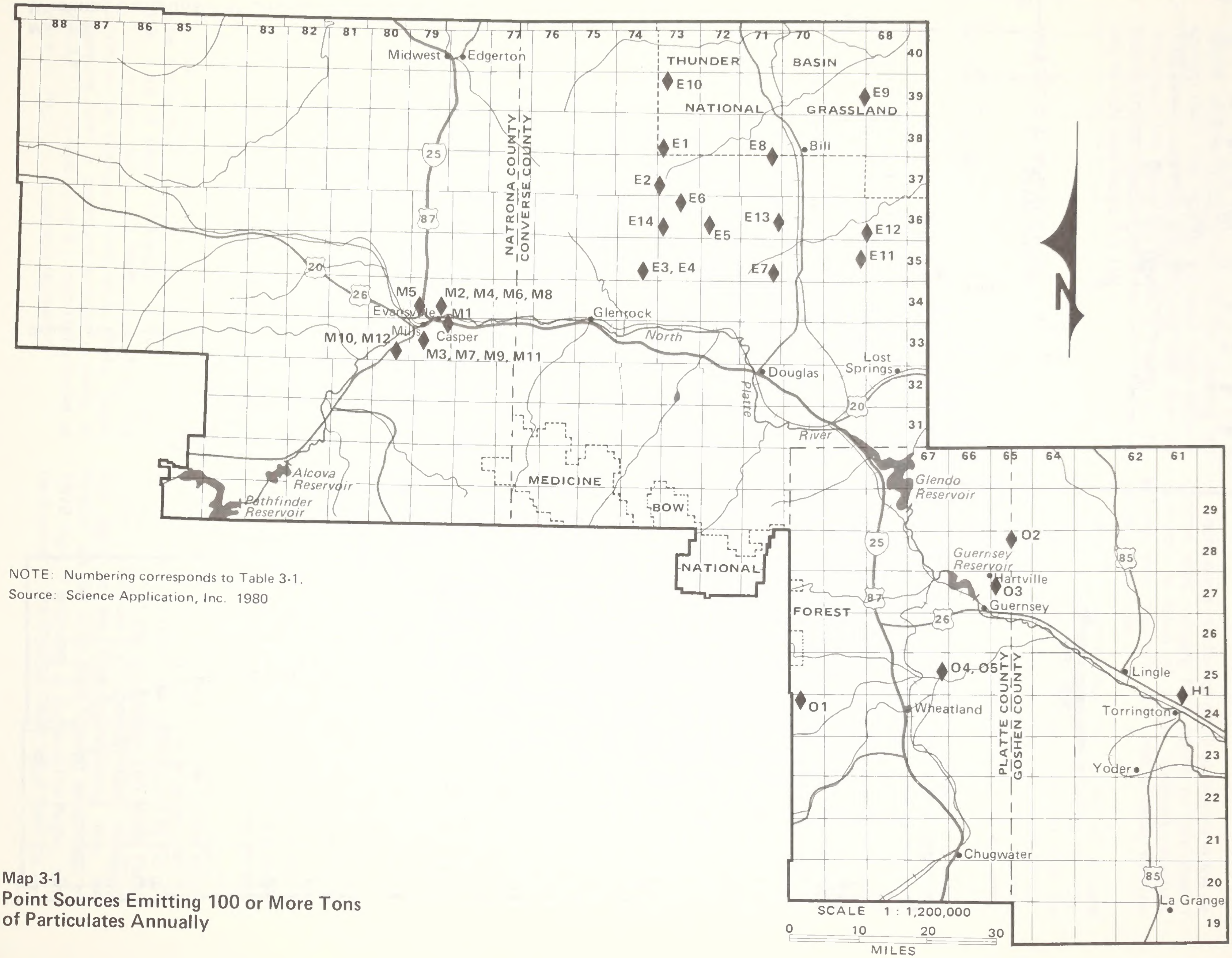
Monitor Location	Winter		Spring		Summer		Fall		Annual	
	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.
Casper City	8	28	4	24	0	0	0	0	6	28
Irene Ranch	0	1	0	1	0	2	0	1	0	2
Wheatland	0	1	0	1	1	4	0	1	0	4

Science Applications, Inc. 1980

TABLE 3-5
POINT SOURCES EMITTING 100 OR MORE TONS OF POLLUTANTS PER YEAR

Site	County	Name
E-1	Converse	Bear Creek Uranium
E-2	Converse	Kerr-McGee Nuclear
E-3	Converse	Pacific P. and L. Coal Mine
E-4	Converse	Pacific P. and L., Dave Johnson Power Plant
E-5	Converse	United Nuclear
E-6	Converse	United Nuclear
E-7	Converse	Panhandle Eastern Pipe Line Co., Douglas
E-8	Converse	PEPL Co., Mikes Draw
E-9	Converse	PEPL Co., Poison Draw
E-10	Converse	PEPL Co., Poison
E-11	Converse	PEPL Co., Hogs Draw Field Booster
E-12	Converse	PEPL Co., Well Draw Booster
E-13	Converse	PEPL Co., Yoss Booster
E-14	Converse	Exxon, USA
H-1	Goshen	Holly Sugar
M-1	Natrona	C.J. Abbot, Inc.
M-2	Natrona	Amoco Oil Co.
M-3	Natrona	Benton Clay Co.
M-4	Natrona	Black Hills Bentonite (Kaycee Bentonite)
M-5	Natrona	Boatwright Smith
M-6	Natrona	Casper Concrete
M-7	Natrona	Great Lake Carbon
M-8	Natrona	Little America Refinery
M-9	Natrona	McMurry Bros.
M-10	Natrona	Rissler McMurry
M-11	Natrona	Texaco Inc.
M-12	Natrona	Benton Clay Co.
0-1	Platte	Basin Engineering
0-2	Platte	Colorado Fuel and Iron
0-3	Platte	Guernsey Stone
0-4	Platte	Missouri Basin Power Project
0-5	Platte	Basin Electric, Laramie River Station

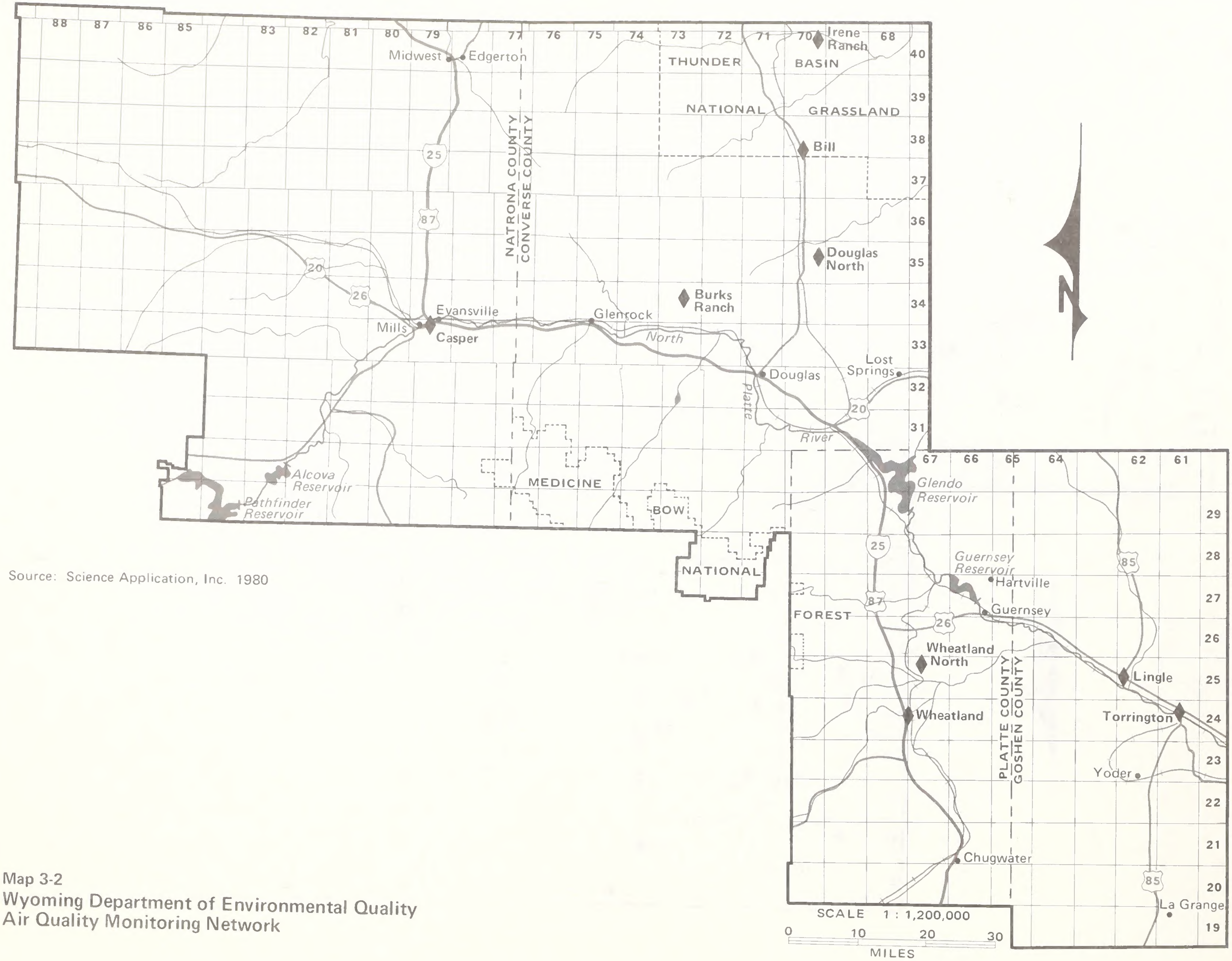
Refer to Map 3-1
Science Applications, Inc. 1980



NOTE: Numbering corresponds to Table 3-1.

Source: Science Application, Inc. 1980

Map 3-1
Point Sources Emitting 100 or More Tons of Particulates Annually



Source: Science Application, Inc. 1980

Map 3-2
Wyoming Department of Environmental Quality
Air Quality Monitoring Network

trogen dioxide (NO_2) seems to be showing an upward trend over most of the state. Data indicate that annual averages for SO_2 and NO_2 are low throughout the state. No values in excess of the federal annual standard have been noted in either SO_2 or NO_2 (see tables 3-3 and 3-4).

WATER RESOURCES

Surface Water

The PRA is drained by tributaries of the Missouri River system. The main sub-basins are the North Platte, Cheyenne, Powder, Niobrara, and Wind rivers.

Peak streamflows of most streams occur from April through June, corresponding to the period of maximum precipitation and snowmelt. Discharge in the North Platte River is controlled primarily by a system of dams and reservoirs designed for hydroelectric production and irrigation; therefore, peak flow on the North Platte occurs in August during the time of maximum release for irrigation. Many of the smaller streams in the resource area are intermittent.

The North Platte River and its tributaries provide the largest surface water yield in the PRA. In water year 1979 (October 1978 through September 1979) the North Platte discharged an average of 1,405 cubic feet per second (cfs) at Glenrock in Converse County. The two largest tributaries, the Sweetwater and the Laramie, contribute an average of 126 and 136 cfs, respectively. In contrast, the largest Powder River basin streams are the South Fork of the Powder, which discharged an average 35.1 cfs in water year 1979, and Salt Creek, which flowed at an average of 41.2 cfs. Antelope Creek in the Cheyenne Basin averaged 7.09 cfs in water year 1979. Water year 1979 streamflows and water yields of selected streams in the PRA are summarized in table 3-6.

More detailed information on streamflows for different years and sites can be found in the annual GS publications, *Water Resources Data for Wyoming*.

There are seven major reservoirs in the resource area with a storage capacity exceeding 5,000 acre-feet. Four of these—Pathfinder, Alcova, Glendo, and Guernsey—are on the North Platte River. The others are on tributaries of the North Platte. These reservoirs have a combined storage capacity of 2,098,510 acre-feet. They are important sources of water for irrigation, power, and recreation.

There are a number of small reservoirs in the resource area, ranging from ponds of less than 1 acre-foot to lakes of a few thousand acre-feet. These small reservoirs are used primarily for livestock and irrigation.

Table 3-7 summarizes the quality of surface water from selected stations. The values are flow-weighted averages calculated from GS data for water year 1979. More detailed information for various dates and sites can be found the in annual publications, *Water Resources Data for Wyoming*, by the GS.

Concentrations of dissolved substances are relatively low in the North Platte River compared to other waters in the resource area. Total dissolved solids (TDS) averaged 302 milligrams per liter (mg/l) at Alcova in Wyoming (1979), increasing to 542 mg/l at the Wyoming-Nebraska line. The increase in salts concentrations at successive downstream stations is primarily due to return flow from irrigation. The increase in sodium adsorption ratio indicates an increase in the proportion of sodium ions relative to these cations and a reduction in the quality of the water for irrigation purposes.

The highest concentrations of salts and dissolved solids are found in Salt Creek, where TDS averaged 4,270 mg/l at Sussex in water year 1979. This figure is based on flow-weighted data from the GS. (See Appendix 3 and table 3-7 for Wyoming standards.) The high concentrations are due to large discharges of oil field brines from oil treater facilitites in the Teapot and Salt Creek oil fields.

Table 3-7 includes water quality data for the Powder River above and below the confluence with Salt Creek. The sampling stations are about 13 miles north of the PRA; however, much of the watershed lies within the PRA. The data illustrate the effects of the polluted tributary on the larger stream.

The Powder River at Sussex, Wyoming, discharged 164,600 acre-feet in water year 1979, of which Salt Creek contributed 29,860 acre-feet. TDS increased from 778 mg/l at Kaycee, above the Salt Creek confluence, to 1,656 mg/l at Sussex, below the confluence. Chloride concentration increased almost sixfold, from 42.2 mg/l at Kaycee to 244 mg/l at Sussex.

Streams in the resource area show a wide range of sediment concentrations. This is largely due to the variability of surface disturbance and to the dynamics of runoff and streamflow. The North Platte carried a relatively light sediment load, averaging 160 mg/l at the Wyoming-Nebraska line; the Powder, on the other hand, carried an average of 1,972 mg/l of sediment at Sussex. The higher concentrations in the Powder River result from the dy-

TABLE 3-6
STREAMFLOWS AND WATER YIELDS AT SELECTED STATIONS IN THE PLATTE RESOURCE AREA
WATER YEAR 1979

Stream/Station	Mean Discharge (cfs)	Minimum Discharge (cfs)	Maximum Discharge (cfs)	Yield (acre-feet)	Runoff (inches/year)
North Platte Basin					
North Platte at Alcova	1,330	502	3,710	962,900	1.68
North Platte at Glenrock	1,405	520	4,260	1,017,000	1.41
North Platte at WY-NE line	529	98	1,610	382,700	0.32
Cheyenne River Basin					
Antelope creek near Teckla	7.09	0.10	1,760	5,130	0.10
Dry Fork near Bill	3.51	0.00	81	282	0.04
Powder River Basin					
North Fork Buffalo Creek	3.02	0.83	64	2,190	5.07
South Fork Powder near Kaycee	35.1	0	384	25,390	0.41
Powder River near Kaycee	114	0.73	965	82,290	0.13
Salt Creek near Sussex	41.2	14	567	29,860	0.061
Powder River near Sussex	227	24	2,350	164,600	0.083

Source: U.S. Department of the Interior, Geological Survey 1980. *Water Resources Data for Wyoming: Vol. 1, Missouri River Basin.* Water Data Report WY-79-11.

TABLE 3-7
SURFACE WATER QUALITY, WATER YEAR 1979
FLOW-WEIGHTED AVERAGE VALUES

Stream/Station	Temp.	Specific Conductivity	Total Dissolved Solids[1]	Total Suspended Solids	Chloride	Sulfate	pH	Sodium Adsorption Ratio	Dissolved Oxygen	Hardness
N. Platte River										
at Alcova	9.7	490	302	---	9.2	117	8.2	1.0	10.4	60
at Glenrock	16.4	550[2]	459	---	13.5	197	8.7[2]	1.5	---	225
at WY-NE line	14.7	814	542	160	16.7	213	8.1	2.0	8.8	261
Powder River Basin										
at Kaycee	5.2	1,162	778	---	42.2	369	8.0	1.9	10.9	432
at Salt Creek near Sussex	8.1	7,596	4,270	1,284	1,036	1,263	8.2	34.0	8.1	389
Powder at Sussex	6.0	2,503	1,656	1,972	244	709	8.1	7.1	9.1	498
Cheyenne River Basin										
Antelope Creek	15.0	1,546	1,182	252	15.0	702	8.2	2.5	8.5	317
Dry Fork	4.8	2,188	1,701	20	19.2	985	7.7	0.93	9.7	881

[1] Sum of Constituents

[2] Datum for 6-29-79 only

Source: U.S. Department of Interior, Geological Survey 1980. Water Resources Data for Wyoming: Vol. 1, Missouri River Basin. Water Data Report WY-79-11.

Note: See Appendix A-3 for effluent limitations for produced water in Wyoming.

Flow-Weighted average is computed by multiplying the discharge for a sampling period by the concentrations of individual constituents for the corresponding period and dividing the sum of the products by the sum of the discharges. A discharge-weighted average approximates the composition of water that would be found in a reservoir containing all the water passing a given location during the water year after thorough mixing in the reservoir.

namic nature of the river; that is, the wide variation between minimum and maximum flows, and the more sparse vegetation of the arid Powder River basin as compared to the North Platte watershed.

Salt Creek has relatively constant flows, yet the sediment load is high. The high total suspended solids (TSS) levels in Salt Creek are due to the high degree of surface disturbance in the oil fields of the Salt Creek watershed. This disturbance includes an extensive network of roads, numerous well sites and oil treaters, and a low density of vegetation.

Groundwater

The important aquifers in the Powder River basin of northern Natrona County are Quaternary alluvial deposits and the Wasatch and Fort Union formations.

Dissolved solids in water from alluvium commonly range from 500 to 1,500 mg/l. Well yields range from a few to more than 1,000 gallons per minute (gpm).

The Wasatch Formation is composed of layers of sandstone, shale, and coal. Its greatest thickness is about 1,600 feet along the central axis of the Powder River basin. Dissolved solids in water from the Wasatch range from 500 to 1,500 mg/l, and well yields vary from 10 gpm in the northern part of the basin to 500 gpm in the southern part.

The Fort Union Formation is also composed of sandstone, shale, and coal layers. It underlies the Wasatch in the central part of the basin but is exposed on the edges of the basin. The Fort Union Formation is up to 3,400 feet thick. Water from the Fort Union commonly contains 500 to 1,500 mg/l dissolved solids, and maximum well yields are about 150 gpm.

Most of the groundwater from wells in the area is used for domestic use and livestock. It is obtained from drilled wells and springs. The quality of groundwater is generally considered fair to poor for domestic use and good to poor for livestock.

The groundwater bearing formations of the Cheyenne River basin in northern Converse County are primarily Tertiary in age and include consolidated sandstones that may yield up to 600 gpm from depths of more than 1,000 feet. Flowing wells are possible in this area. There are only a few aquifers capable of supporting sustained yields of great magnitude. Sandstone of the Fox Hills and Inyan Kara sequences are believed to be capable of supplying individual well yields of more than 100 gpm from depths to more than 6,000 feet below the surface. Most wells are reported to yield lesser amounts. A few have reported yields of up to 300 gpm in the Inyan Kara Formation and 500 gpm in the Fox Hills Sandstone.

Dissolved solids in water from wells in the Fox Hills Sandstone are generally less than 1,000 mg/l, and dissolved solids in the Inyan Kara Group range between 300 and 3,000 mg/l.

The groundwater bearing formations in the Platte River basin are diverse and complex. The availability of water in the alluvium of the North Platte is assumed to be good (Wyoming Water Planning Program 1971). The alluvium of Horseshoe Creek in Platte County supplies water for livestock, domestic use, and irrigation, but the adequacy of alluvial aquifers in tributary valleys is for the most part unknown.

The alluvium thickness along the Platte River is about 80 feet, and alluvial aquifers should yield at least several hundred gpm. The water quality is highly variable, but TDS concentrations generally range between 250 and 1,500 mg/l. The city of Casper withdraws 11,500 acre-feet per year for domestic use from shallow wells near the North Platte.

Tertiary formations in the western part of the PRA are separated from those to the east by the Casper Arch and Laramie Mountains. The overall potential of aquifers in the western part is unknown.

In the east, the Arikaree supplies water to numerous domestic and livestock wells. Moderate yields might be obtained from fractured Brule in Platte and Converse counties. Water might also be obtained from the lower part of the Chadron Formation. The potential of the Wasatch is poor because its extent in the area is limited. Several domestic and livestock wells obtain water from the Fort Union Formation.

The most important of the pre-Tertiary aquifers are the Casper and Hartville formations in the vicinity of Glendo in Platte County. The uppermost "Converse Sand," or the Hartville, reportedly has the potential to flow as much as 175 gpm through wells. A spring in Natrona County reportedly flows 7,500 gpm from Tensleep Sandstone. Depth to aquifer has deterred drilling in much of the area.

Water quality is generally high in the Casper Formation, with some wells producing water with as little as 200 mg/1 TDS. The "Converse Sand" yields high quality water containing 200 to 300 mg/1 TDS. Deeper wells in the Hartville Formation yield slightly more mineralized water of about 400 mg/1 TDS. The quality of water from the Tensleep Sandstone varies widely, ranging from about 300 mg/1 to 3,000 mg/1 TDS from wells in different locations.

TOPOGRAPHY

Topography in the PRA is generally gentle to steep rolling plains. Areas of steeper slopes, up to and in excess of 100%, are found in the mountains and along some of the major drainages (see map 4 in Appendix 9).

Some areas with extremely steep topography are the South Big Horn Mountains, Rattlesnake Mountains, Red Wall, Powder River Breaks, Pine Mountain, Pine Ridge, Casper Mountain, and Muddy Mountain in Natrona County; the Laramie Mountains in Converse and Platte counties; the Deer Creek Mountains and Cheyenne River breaks in Converse County; the Rawhide Mountains and Hay Stack Mountains in Platte County; and the Goshen Hole Rim in Goshen County.

Through the MFP process, areas have been identified where no surface occupancy and no leasing will be permitted because of steepness of slope and shallowness of soils. Map 4 in Appendix 9 identifies these areas in Natrona, Converse, and Platte counties. Natrona County areas identified total 2,440 acres in the Rattlesnake Range, the back side of Muddy Mountain, and Negro Hill. Areas identified in Converse County along the north side of the Laramie Range between Casper and Douglas total 2,200 acres. A total of 1,420 acres have been identified in the southwest corner of Platte County.

A memorandum written by the deputy conservation manager of Resource Evaluation, GS, to the Casper District office of the BLM discusses the oil and gas potential in the areas recommended for no leasing. This memorandum is on file in the Casper District office.

SOILS

The SCS has made a number of soil surveys in the PRA.

The Wyoming General Soil Map, published by the University of Wyoming (1977), divides the five-county region into 21 mapping units. The survey was based primarily on physiographic, topographic, and climatic features. The soils were identified at the great group level of the soil taxonomy. This provides gross information on soil characteristics. On the basis of this information, soils within the PRA can be described as follows:

Forty-four percent of the area is characterized by rolling to steep slopes having soils formed in the residuum of interbedded sandstone, siltstone, and shale. The soils are shallow to very deep (less than 20 inches to more than 60 inches deep) with loamy and clayey textures.

There is little evidence of pedologic development on the steeper slopes, although argillic horizons (red subsoils) may be present on the flatter, more stable areas. Soils typical of this description occur throughout the resource area and are designated as P4, P5, P6, P7, and P8 on the General Soil Map.

Nearly level to rolling upland plains, terraces, and fans are found in 33% of the resource area. Generally, the soils are moderately to very deep (more than 20 inches deep) and have argillic horizons. Soil textures are loamy. In Platte and Goshen counties these soils have mollic epipedons (dark surfaces) characteristic of higher rainfall and greater organic matter content. Soils typical of this description occur principally in the eastern half of the resource area and are designated as P13, P14, P16, P17, P18, P19, P20, and P21 on the General Soil Map.

The rolling to very steep slopes of the Big Horn, Laramie, and Rattlesnake Mountains make up 10% of the area. The soils have developed from residuum and transported materials derived from igneous and sedimentary rocks. They are shallow to very deep and generally have mollic epipedons or albic horizons (sand layers bleached by eluviation). Soils typical of this description are designated as MC2, MC3, MF1, MF2, and MF3 on the General Soil Map.

Nearly level to gently sloping floodplains occurring adjacent to the Platte River and other major streams cover 6% of the area. The soils are generally deep (more than 60 inches) and loamy in texture. The soils show varying degrees of stratification. Soils that do not get reworked by storm runoff have formed argillic horizons. Soils typical of this description are designated P2 and P3 on the General Soil Map.

Rolling to hummocky soils formed in aeolian sands compose 4% of the PRA. The soils are very deep and have no pedogenic development. These soils occur in central Natrona and Goshen counties. These areas are identified as P1 on the General Soil Map.

The remaining 3% of the resource area is made up of small areas of miscellaneous soil types having shallow to steep slopes and derived from various source materials.

The statewide General Soil Map is complemented by more detailed general soil maps prepared for each county. These maps show a higher degree of detail than the statewide map because scales are higher; however, both the state and county based maps are composed of very broad delineations, each covering many townships. The data are intended to be applicable only regionally. Site-specific interpretations are not possible from information on these maps.

In addition to the General Soil Maps, more detailed surveys (third order) are in varying stages of completion. These surveys, which have delineations as small as 10 acres, have broad applicability to a wide range of interpretations. Site-specific information still is needed for assessing project feasibility; however, the likelihood of finding soils vastly dissimilar from those described on the soil map is greatly reduced. Only south Goshen County has a published third order soil survey.

The topsoil is the soil resource most affected by oil and gas development. Topsoil, which is the soil material with the physical and chemical properties capable of establishing and maintaining native vegetation, may be several inches or several feet thick, depending on the soil characteristics.

Soil texture is determined on the basis of its sand, silt, and clay content. Soils with high silt and clay contents will have a high moisture-holding capacity but low infiltration and permeability. Soil textures having these properties include clay loams, silty clays, and clays.

Soil erosion is a two-part process involving the detachment of soil materials from the ground surface and the transport of these materials (EPA & BLM 1979). Gross transport of soil material does not begin until the soil's infiltration rate is exceeded and surface flow begins (Ellison 1947). Low infiltration rates and subsequent soil erosion depends primarily on the soil's texture, chemical composition, physical characteristics, and the content of organic matter and rock fragments. The effects of any combination of these variables are greatly magnified by topography.

Generally, as surface soil texture gets heavier, infiltration decreases. Once surface flow begins, it is the very fine sand (0.1 to 0.05 mm) and silt (0.05 to 0.002 mm) fractions that are most susceptible to water erosion (USDA 1978). A soil containing a predominance of either of these particle size classes becomes highly susceptible to water erosion if disturbed.

Soils high in sodium content are subject to deflocculation. This can result in the formation of thin surface crusts, which drastically impede water infiltration. The deflocculated nature of these soils can cause increased water runoff, which can result in serious erosion problems.

Soil structure as characterized by the degree of aggregation of the soil peds is another factor affecting erosion. Soils with weak or no surface structure are susceptible to water movement soon after runoff begins. Conversely, strong structures like those common for exposed subsoils may severely impede water infiltration and increase runoff.

With increasing organic matter content the soils' susceptibility to water erosion decreases. Organic matters in the soil increases soil porosity and is effective in making stable soil aggregates.

As rock fragment content increases, susceptibility to erosion decreases. This relationship is true for all soils of any texture.

Relative rates of water erosion on disturbed soil also can be predicted on the basis of the soil's unified classification. This classification can be determined through simple field methods (Stevenson and Talbot 1975). With practice, one can become proficient in determining these classifications. The unified classifications are related to relative erosion rates on the "erosion index" (USDI, BLM, Wyoming State Office Manual Supplement 3109, Appendix 4, pages 6 through 8). The erosion index can then be used to determine maximum culvert spacing on access roads of various slopes. The table used to derive these values also appears in the preceding reference.

The soils most susceptible to wind erosion are those with sand or silt textures. Generally, as the content of clays, carbonates, moisture, or rock fragments in soils increases, the susceptibility of soils to wind erosion decreases. Unlike water erosion, wind erosion generally is not related to slope gradient (USDA, SCS 1981).

BIOLOGICAL RESOURCES

VEGETATION

The vegetation of the PRA varies widely with varying soil types, topography, and moisture conditions. Intermixed sagebrush-grassland predominates. Some of the higher ridges contain pine and juniper, and patches of conifer forest are found in the mountainous area. Technical range site descriptions published by the SCS show common plant species found in different soils and precipitation zones (See Appendix 4). The resource area contains ten of these zones.

Sagebrush-grassland is the predominant vegetative type in the 5-inch to 9-inch precipitation zones in the Big Horn and Wind river basins, the 10-inch to 14-inch Northern Plains and High Plains southeast, and the 12-inch to 14-inch Southern Plains. As one moves east to the Southern Plains, the sagebrush becomes less dense and other grasses are more prominent, including blue grama, buffalo grass, needle-and-thread, prairie sandreed, the bluestems, and three-awn grasses. Saline soils within these zones produce greasewood, saltgrass, western wheatgrass, and saltbush.

As the precipitation increases, forested areas become more common. The higher ridges in the 15-inch to 17-inch Northern Plains and the 15-inch to 19-inch Foothills and Mountains East and Southeast contain stands of limber pine, ponderosa pine, and lodgepole pine. Aspen groves become common in the foothills and mountain zones. North-facing slopes begin to produce some spruce and fir.

More detailed descriptions of vegetative types found in the resource area can be found in range survey publications for the Missouri River basin. These are on file at the BLM's Casper District Office. These surveys were conducted between 1952 and 1965.

Table 3-8 shows the relative importance of the nine zones described above. Map 3-3 shows the locations of these zones.

Range site technical guides and SCS range seeding technical guides (Appendix 4) are combined to provide oil and gas site reclamation stipulations for reseeding (see Map 3-3).

No threatened or endangered species of vegetation have been identified in the PRA.

WILDLIFE

Terrestrial Wildlife

A total of 82 mammal, 305 bird, 25 fish, and 25 reptile and amphibian species are known to be in the PRA (BLM, Natrona URA II, Converse URA II). Big game populations and habitats are described in detail in the URA III documents (BLM 1977, 1976). This information is summarized in table 3-9 and in map 2 in Appendix 9.

Sage grouse are the primary game birds that would be affected by oil and gas activities. There are major sage grouse populations in Natrona and Converse counties, while Platte and Goshen counties provide only marginal habitat. The annual harvest has been 4,000 to 5,000 birds in Natrona County and 500 to 650 birds in Converse County. A total of 73 strutting grounds have been identified in the resource area.

Wild turkeys can be found on 180,000 acres in Natrona, Converse, and Platte counties, primarily on private lands.

Golden eagles and prairie falcons are the most common species of raptors. Other species include the great horned owl, red-tailed hawk, Swainson's hawk, and ferruginous hawk. A total of 226 nests have been located; however, not all of these are active every year.

Two endangered species are found in the resource area, the bald eagle and the black-footed ferret. Bald eagles are discussed extensively in Natrona URA III (BLM 1977). They are also found in the other three counties. Approximately 150 to 200 bald eagles winter here from late October to early April. This is one of the largest wintering populations in the Rocky Mountains. The habitat includes eight night roosts in secluded canyons and feeding areas along the North Platte River and throughout the upland rangelands.

Black-footed ferrets historically have been found in east central Wyoming. There have been sightings, both verified and unverified, within the resource area since 1851, when the type specimen was collected near Fort Laramie, Goshen County (Clark 1977). Eighteen sightings or collections have been documented by Clark (1977); half of these have occured since 1972.

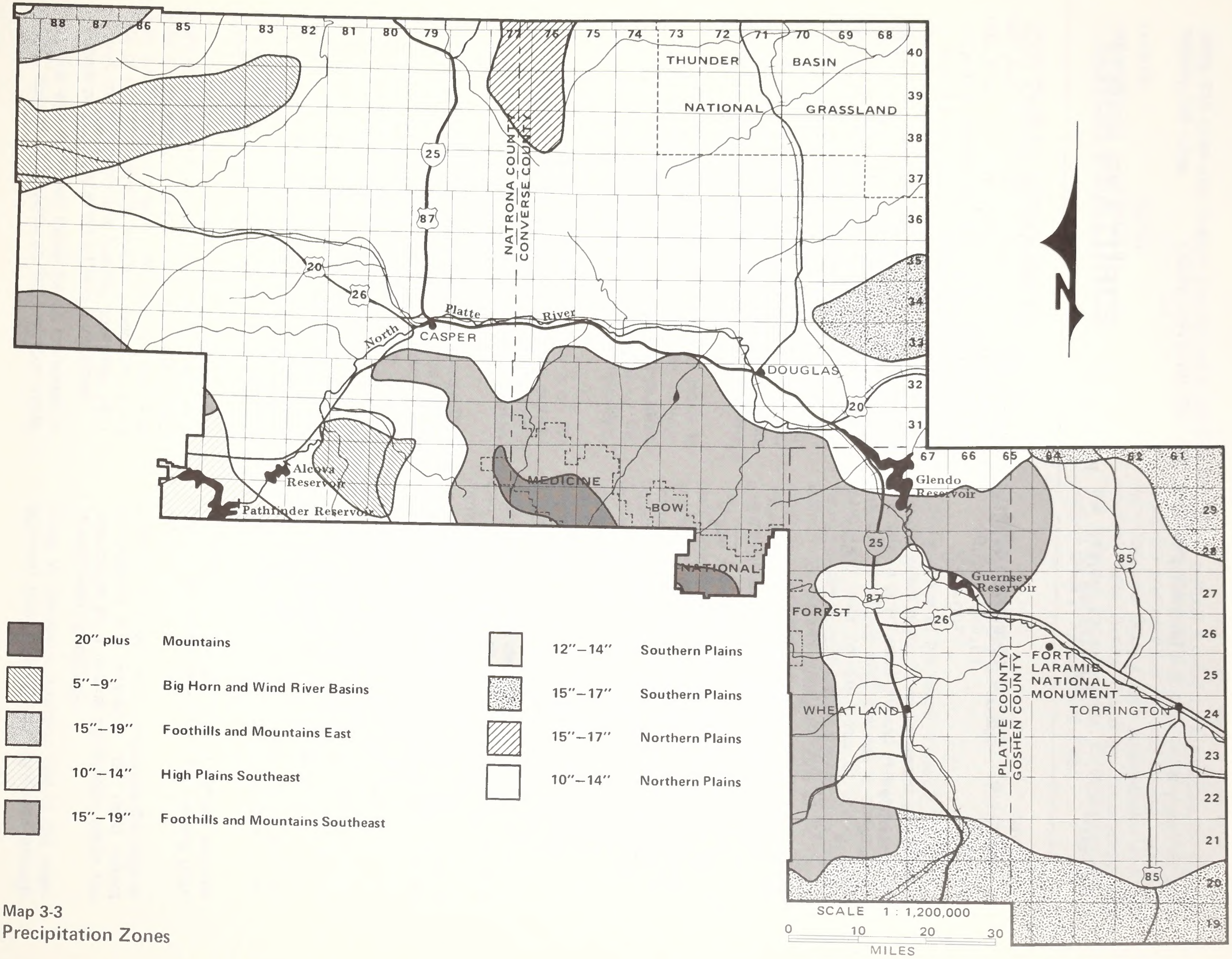
The primary habitat for this species is prairie dog towns. Any prairie dog town should be considered potential black-footed ferret habitat until field investigation can verify the presence or absence of ferrets. In Natrona County, 21 towns comprising 4,024 acres have been mapped. This is less than half of the towns identified in this county. Mapping has not been done in other counties, although the locations of some towns are known.

Aquatic Wildlife

Thirty-two streams are classified as fisheries; these flow a total distance of 266 miles in Natrona County. The conditions of the streams and type of fisheries are discussed in Natrona URA III (BLM 1977). In Converse County there are 23 streams totaling 302 miles. Platte County has 17 streams to-

TABLE 3-8
VEGETATION-PRECIPITATION ZONES AS A PERCENTAGE OF TOTAL AREA

Zone	Natrona County	Converse County	Platte County	Goshen County	Oil & Gas Activity
10-14" Northern Plains	67%	71%	7%		High
15-17" Northern Plains	1	2			Moderate
12-14" Southern Plains			44	79%	Low
15-17" Southern Plains		3	13	20	Low
5- 9" Big Horn & Wind River Basins	11				Moderate
10-14" High Plains-SE	10				Low
15-19" Foothills & Mtns. East	1				Low
15-19" Foothills & Mtns. SE.	9	22	36	1	Low
20" + Mountains	1	2			None
	100%	100%	100%	100%	



Map 3-3
Precipitation Zones

TABLE 3-9
BIG GAME POPULATIONS AND HABITAT AREAS

County	Population 1/	Harvest 1/	Total Habitat (Acres)	Winter Habitat (Acres)
Natrona				
Antelope	19,000-27,000	4,500-5,000	3,000,000	345,000
Deer	13,000-18,000	4,000-5,000	900,000	400,000
Elk	500-850	170-270	310,000	27,000
Converse				
Antelope	---	5,000-5,000	1,500,000	110,000
Deer	---	3,700-4,800	1,100,000	23,000
Elk	600	130-200	220,000	38,000
Bighorn sheep	---	5	77,000	1,000
Platte				
Antelope	---	500-900	1,300,000	---
Deer	---	1,000-1,500	1,200,000	70,000
Elk	75+		14,000	---
Goshen				
Antelope	---	400-1,100	900,000	---
Deer	---	500	550,000	---
Elk	---	10-11	10,000	---

Source:

1/ Big Game Completion Reports, Wyoming Game and Fish Department
2/ URA III Documents: Natrona 1977, Converse 1977, Lower Platte 1976.

taling 243 miles and Goshen County has 8 streams totaling 206 miles.

OTHER FEATURES

CULTURAL RESOURCES

Cultural evidence in the PRA is documented back in time for 12,000 years (Saul 1964). Throughout the continuum from this early time until the historic tribes were defeated by the U.S. Army in the late 19th century, Indians left behind evidence of their presence. This evidence is manifested in campsites, animal kill sites, rock art panels, stone circles, firepits, tool stone quarries, religious areas, and special use areas for vegetal food processing or animal butchering. Sometimes these sites are easily recognized—stone circles, for example. In other sites, artifacts are widely dispersed and assume a very low visibility.

European contact with the indigenous tribes is believed to have occurred in the mid-18th century. Subsequent exploration by trappers, homesteaders, military groups, miners, and ranchers led to the presence of military forts, trails, homesteads, mines, and trading posts.

Further information and documentation is on file in the Casper BLM District office library and cultural resource files. Sites on or eligible for the National Register of Historic Places are identified in Appendix 5 and on map 3 in Appendix 9.

The Casper BLM District cultural resource files show that insufficient data exist for accurate prediction of significant cultural resource locations in the resource area; that is, not enough of the environment in PRA has been intensively inventoried to allow accurate prediction of significant cultural site densities. However, a sampling of cultural resouce inventory reports resulting from oil and gas activities has generated some data from which tentative general inferences may be made. These data, including a site density breakdown by county, are shown in tables 3-10 and 3-11.

A desirable goal of a viable cultural resource program would be the accurate prediction of the locations of significant cultural sites. Accurate predictions could be based upon field intensive survey of 10% of the land surface, randomly selected, within a given management unit (county, township, etc.). This type of study would be a Class II inventory.

To this end, the need exists for an increased intensive survey, particularly on BLM surface lands. Class II cultural inventories conducted for the purpose of generating predictive models are needed in southern and northern Natrona County, northwestern Converse County, and southeastern and east central Platte County. These are the locations with the greatest concentrations of BLM-administered federal lands in the resource area.

VISUAL RESOURCES

The purpose of the visual resource management (VRM) system is to set management objectives for maintaining or enhancing visual resources on public lands. One of five VRM classes is assigned to a given land area on the basis of scenic quality, visual sensitivity, and distance zone (see matrix in table 3-12). Scenic quality is rated as A, high; B, moderate; or C, low, depending on the presence or absence of water, intrusions, unusual landforms, and variations in color and vegetation.

Visual sensitivity levels are determined by people's concern for what they see. Usually the highest sensitivity areas lie near communities, recreation areas, and heavily traveled highways. There are three distance zones: foreground-middleground (0 to 5 miles from a travel route or observation point), background (from 5 miles to a maximum of 15 miles from an observation point), and seldom seen (along infrequently used roads or beyond 15 miles from an observation point).

Each VRM class describes a different degree of modification which should be allowed in the basic elements of the landscape.

> Class I: This class provides for natural ecological changes only. It is applied to primitive areas, some natural areas, and similar situations where activities are to be restricted.
>
> Class II: Changes in any of the basic elements (form, line, color, or texture) should not be evident in the characteristic landscape).
>
> Class III: Changes in the basic elements (form, line, color, or texture) may be evident in the characteristic landscape.
>
> However, the changes should remain subordinate to the visual strength of the existing character.
>
> Class IV: Changes may subordinate the original composition and character, but must reflect what could be a natural occurrence within the characteristic landscape.
>
> Class V: Intrusions overlying one of the management classes (I-IV) are significant enough

TABLE 3-10
ACREAGE SURVEYED FOR CULTURAL RESOURCES AT THE CLASS III LEVEL--PLATTE RIVER RESOURCE AREA

County	BLM Surface	Split Estate	BLM/Split Estate Surface Total	Acreage Surveyed Class III	Acreage Surveyed as Percentage of Total Surface	Number of Sites Found
Natrona	1,454,036	1,275,191.04	2,729,227.00	48,779	1.8	214
Converse	144,186	1,216,754.08	1,360,243.18	57,139	4.2	100
Platte	82,240	319,206.54	401,446.54	7,422	1.8	37
Goshen	26,737	209,754.08	236,491.08	2,309	1.0	9
Totals	1,707,199	3,020,208.00	4,727,407.00	115,649	2.2	360

TABLE 3-11
CULTURAL RESOURCE SITE DENSITIES BY COUNTY PLATTE RIVER RESOURCE AREA

County	Sites per Section	Sites per Township	Total Sites BLM Surface	Total Sites Split-Estate Surface	Sites on Combined BLM and Split-Estate Surface
Converse	1.1	39.6	247.8	2,090.1	2,337.9
Goshen	2.5	90.0	104.4	819.4	923.8
Natrona	2.8	100.8	6,361.4	5,579.0	11,940.4
Platte	3.2	115.2	411.2	1,596.0	2,007.2
Averages	2.4	86.4	1,781.2	2,521.1	4,302.3

TABLE 3-12
VISUAL RESOURCE MANAGEMENT CLASS DETERMINATION

		Visual Sensitivity Level						
		High			Medium			Low
SPECIAL AREAS		I	I	I	I	I	I	I
SCENERY CLASS	A	II	II	II	II	II	II	II
	B	II	III	IV	III	IV	IV	IV
	C	III	IV	IV	IV	IV	IV	IV
		FG	BG	SS	FG	BG	SS	SS
		Visual Zones						

NOTE: FG = Foreground-middleground (0-5 miles from observation point)
BG = Background (5-15 miles from observation point)
SS = Seldom seen (along infrequently used roads or beyond 15 miles from observation point)

Class I applies only to classified special areas such as wilderness, primitive, and natural areas. This quality standard is established through legislation or policy.

Class V applies to areas identified in the scenery quality inventory where the quality class has been reduced because of unacceptable intrusions.

to jeopardize effective management until the intrusions are removed.

The characteristic natural landscape in the PRA varies from forested mountains to rolling plains. There also are areas that have been altered by the development of coal mines, oil and gas fields, and increased urbanization.

The predominant VRM clases in the planning unit are III and IV; however, there are several scenic areas that have been rated Class II and are of special concerns for protection: Fremont Canyon, the Red Wall and the foothills of the South Big Horn Mountains in northern Natrona County, and portions of the Laramie Mountain Range in Converse County. These areas comprise approximately 207,000 acres, or less than 5% of the total land area under the responsibility of the resource area office. VRM classes are shown on map 3 in Appendix 9.

A detailed explanation of the VRM system and its application can be found in the U.S. Government publication, *Visual Resource Management*, which is available through the U.S. Government Printing Office, Washington, D.C. 20402 (Stock No. 024-011-00116-6).

Management classes are established to describe the different degrees of modification allowed to the basic elements of the landscape. Class designations are derived from an overlay technique that combines the maps of scenic quality, sensitivity levels, and distance zones. The overlays are used to identify areas with similar combinations of factors. These areas are assigned to one of five management classes according to predetermined criteria.

Map 3 in Appendix 9, which depicts contiguous areas sharing the same VRM class, is an important document in BLM land use planning. It is also used to assess the visual impact of proposed development.

NOISE CONDITIONS

The average noise level in the PRA ranges from 30-40dB(A). Higher noise levels occur near urban areas, mining developments, major arterials, railroads, and airports where the noise level may reach 140dB(A). Map 1 in Appendix 9 shows urban areas and major arteries, and table 3-13 gives examples of noise sources.

LAND USES

RESIDENTIAL AREAS

There are 18 incorporated municipalities and 16 unincorporated towns in the PRA. These are identified on map 1 in Appendix 9.

ROADS

There are 5,241 miles of federal, state, and county road in the resource area, and an undetermined number of miles of oil field and other private roads. Table 3-14 shows a breakdown by county.

Maps showing road locations are available from the respective counties. Major arteries are shown on map 1 in Appendix 9.

Information on BLM-approved road rights-of-way is on file in the Casper District office.

POWER SUPPLY

Transmission lines considered in this environmental assessment are relatively small lines (69KV and less) on single wood poles in narrow rights-of-way. Average span lengths occur only where the ground profile is relatively level. Crossing rounded ridges may require several structures, while a sharp ridge may require only one. Long spans are needed to cross deep draws and valleys. Right-of-way widths are usually 50 feet or less, and terms are 30 years, with right of renewal.

There were 3,036 oil wells in the PRA in 1979 (Wyoming Oil and Gas Statistics 1979). Aproximately 50% of these wells are located in the Salt Creek ACEC, where 100% of the wells are electrified. Approximately 25% of the pumps on wells outside the ACEC are powered by electricity. Only those wells within 1 mile of existing power lines are likely to be electrified, and then only if the power supply has not been committed to other customers. Because of the number and complex descriptions necessary to identify these lines, they will not be described here. If further information is needed, records of individual cases are on file at the Casper District office.

TABLE 3-13
DECIBEL READINGS

Source	Noise Level [dB(A)] at the Source	
Soft whisper (15 feet)	0-3	Threshold of hearing
Probable rural prairie or wilderness background noise level	30	Very quiet
Normal conversation	60	
Urban freeway	75-80	Annoying
Heavy truck	90	
Single-cylinder pumpjack engine (unmuffled)*	95-100	
Diesel engine for exploratory drilling (unmuffled)**	100-112	
Thunderclap	120	
Jet takeoff	140	Threshold of pain

Source: U.S. Department of the Interior, Geological Survey 1979.

Note: The most commonly used measure of sound--the decibel (dB) is a logarithmic function; i.e., decibels are not directly additive. A small change in decibel would be a major change in noise intensity. For example, a sound level of 64 dB is twice as intense as a level of 60 dB. The "A" scale of weighing decibels most closely approximates human hearing; therefore, decibels on the "A" scale [dB(A)] are used to indicate sound levels.

The distance from the sound source is a major determinant in the perception of various sounds. Noise drops off 6 dB(A) for every doubling of distance from the source. Actual measurements of noise generated by diesel engine were 102 dB(A) at the exhaust pipes, 75 dB(A) at 400 feet, 64 dB(A) at 900 feet, and 60 dB(A) at 1,500 feet (personal communication, Gary Roggow, Davis Oil Company, October 9, 1979).

* Personal communication, Earl Spieles, Marathon Oil Company, October 19, 1979.

** Personal communication, Gary Roggow, Davis Oil Company.

RANCHING

The majority of land in the PRA is used for livestock grazing. Irrigated and dryland farming accounts for about 6% of the total agricultural land. The average farm operation is a 5,540-acre livestock ranch supporting about 250 animal units yearround. (One animal unit consists of one cow and calf or five sheep). See table 3-15 on ranching statistics. There are 421 ranch operations that hold BLM grazing leases, with a total of 195,000 federal animal unit months being leased.

RECREATION

The abundance of big game, adequate water supply, and open spaces create heavy recreation pressures within the region. This pressure is compounded by the fact that more than 68% of the surface within the PRA is privately owned; therefore, access to these lands for recreational purposes is either limited or unavailable to the general public.

Recreational pursuits in the resource area are most frequently individual activities such as hunting, fishing, camping, sightseeing, rock collecting, and picnicking. Popular hunting and camping areas are located throughout the Laramie and southern Big Horn mountain ranges, portions of which lie within the PRA. These ranges, which offer some of the best big game hunting opportunities in the state, receive intensive use during the fall hunting seasons. The North Platte River and its impoundments (Pathfinder, Alcova, Glendo, and Guernsey) offer opportunities for out-of-state and local residents to participate in water-based recreation.

A significant amount of outdoor recreation activity in the area is in winter sports, including downhill and cross-country skiing, snowmobiling, and ice fishing. Recreation facilities on Casper Mountain and Muddy Mountain are heavily used during both winter and summer. Ice fishing occurs primarily on Goldeneye and Alcova reservoirs. With the exception of downhill skiing, all of these activities take place in dispersed areas where access may be restricted by private surface ownership.

Other dispersed recreational activities—hiking, backpacking, horseback riding, and mountain climbing—occur primarily in the foothills and mountainous areas. The rise in popularity of these activities can be attributed at least partially to the 47% increase in regional population since 1970 and the desire of new residents to participate in outdoor recreation.

The BLM has developed recreation facilities in four of its management areas: Muddy Mountain Environmental Education Area (12,000 acres), Goldeneye Wildlife and Recreation Area (733 areas), Trappers Route Canoe Trail (3,300 acres), and the Buffalo Creek Camping Areas (120 acres). Visitation figures in these four areas during 1980 indicate a 12% increase in visitors from 1979 and an overall 135% increase since 1974.

A more detailed account of the types and intensity of recreation use occurring within the region can be found in the Wyoming Statewide Comprehensive Outdoor Recreation Plan (SCORP—Wyoming Recreation Commission, 1980). Recreation facilities available in the PRA are shown in Appendix 6.

The BLM has identified four ACECs that provide recreational opportunity. These special management areas—the Red Wall, Jackson Canyon, Salt Creek, and the Pterodactyl Paleontological Site—are of both geological and historical importance. See map 1 in Appendix 9 for historic and recreation sites. Facilities at these sites are discussed in Appendix 7.

THE SOCIOECONOMIC ENVIRONMENT

ECOMONICS

Table 3-16 presents a few of the parameters of the affected economic environment as it existed in 1979 and as it is projected to exist in 1990 without continuing present federal oil and gas leasing policies.

The major influencing factor in this area now, and for the forseeable future, is mining. As in other areas in Wyoming, unemployment has been steadily declining; however, recent layoffs in both the uranium and construction industries have caused rises in unemployment. Nevertheless, Wyoming's rate of unemployment still ranks 43rd among the states.

Natrona and Converse counties are likely to continue experiencing significant growth because of expected coal mining activity. The result of this activity could produce a projected increase in population of about 27 percent by 1990 in Converse and Natrona Counties.

TABLE 3-14
MILES OF ROADS

	Federal and State	County
Natrona County	264	825
Converse County	243	660
Platte County	239	1,200 (approx.)
Goshen County	228	1,800

TABLE 3-15
RANCH STATISTICS

County	No. of Stock Sheep	State Ranking	No. of Cattle	State Ranking	Personal Farm Income as a percentage of Total Income
Converse	101,000		60,000		13.4%
Goshen	5,000		93,000		61.2%
Natrona	161,000		48,000		0.7%
Platte	8,000		80,000		43.6%

Source: Socio-economic profile of the Casper District, March, 1977.
Wyoming Agricultural Statistics, 1978.

TABLE 3-16
THE AFFECTED ECONOMIC ENVIRONMENT AS IT EXISTED IN 1979 AND PROJECTED FOR 1990 WITHOUT THE PROPOSED ACTION

	Total Employment	Population	Expenditure Levels
1979:			($1,000)
Converse County	5,056 1/	13,200 2/	8,304.0 3/
Douglas		5,680 2/	6,690.0 3/
School Dist. #1			15,279.5 3/
Glenrock		2,600 2/	1,234.0 3/
School Dist. #2			5,735.0 3/
1990:			
Converse County	8,480 4/	20,400 5/	12,900 6/
Douglas		8,800 5/	10,300 6/
School Dist. #1			23,600 6/
Glenrock		4,000 5/	1,900 6/
School Dist. #2			8,900 6/
1979:			
Goshen County	3,340 1/	11,900 2/	($1,000)
Torrington		5,400 2/	1,899 3/
School Dist. #1			4,137 3/
			7,781 3/
1990:			
Goshen County	3,500 4/	12,200 5/	1,900 6/
Torrington		5,500 5/	4,200 6/
School Dist. #1			8,000 6/
1979:			($1,000)
Natrona County	36,293 1/	69,600 2/	35,668.5 3/
Casper		49,300 2/	41,792.5 3/
School Dist. #1			30,908.8 3/
1990:			
Natrona County	43,070 4/	83,600 5/	42,800 6/
Casper		59,200 5/	50,100 6/
School Dist. #1			37,100 6/
1979:			($1,000)
Platte County	3,815 1/	11,400 2/	2,773.9 3/
Wheatland		5,500 2/	3,147.0 3/
School Dist. #1			6,564.4 3/
Guernsey		1,450 2/	592.9 3/
School Dist. #2			1,278.0 3/
1990:			
Platte County	3,000 4/	10,000 5/	2,400 6/
Wheatland		4,900 5/	2,800 6/
School Dist. #1			5,800 6/
Guernsey		1,250 5/	500 6/
School Dist. #2			1,100 6/

1/ Published by the Wyoming Employment Security Commission.
2/ Estimate based on 1980 census.
3/ Actual FY 1979 expenditures reported by local entities.
4/ See table 4-5 for derivation.
5/ See table 4-6 for derivation.
6/ See table 4-7 for derivation.

SOCIOLOGY

The Department of Education has seen the need to recruit additional teachers, especially in the areas of science and mathematics, to replace many teachers who have chosen more lucrative positions with energy companies, thus creating a void in the educational process.

Law enforcement agencies have hired additional personnel and equipment to ensure adequate protection for the increase in populations, and the Department of Health and Hospitals is actively recruiting for additional medical personnel.

Water and sewage facilities in some of the areas are operating at or near capacity, but plans are being implemented to build new or increase present facilities to accommodate anticipated population increases.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

SCOPE AND ASSUMPTIONS

SCOPE

This chapter identifies the impacts that would result from geophysical exploration, leasing and development, and rights-of-way actions if the proposed action were implemented. Any unavoidable adverse impacts and irreversible or irretrievable commitments of resources that would occur also are discussed, as are the relationship between short-term use of the environment and the maintenance and enhancement of long-term productivity. Impacts that would result from the alternative also are described.

ASSUMPTIONS AND ASSESSMENT GUIDELINES

The following assumptions and assessment guidelines apply to this analysis:

Assumptions

This environmental assessment will be updated in 1990 in conjunction with the required update of the PRA Resource Management Plan. For that reason, the impacts of oil and gas activity are analyzed in this report through 1990.

Reclamation of disturbed land is considered completed when the equipment has been removed, the disturbed land has been recontoured and revegetated, and the reclamation bond has been released. Reclamation of a location or an access road begins when the well is abandoned and requires an average of three years for completion. Recontouring and reseeding of seismic exploration lines, utility lines, and pipelines usually begin after construction of the project is completed.

Impacts lasting after reclamation is completed are considered to be long term.

It is difficult to predict what the oil and gas industry will do about development. (Pers. Comm. Feb. and March 1981, Chuck Farmer, Wyoming Oil and Gas Commission; Rick Robitaille, Petroleum Assoc. of Wyoming). Barlow and Haun predicted that in the event that price deregulation was to take place on oil and gas, which recently occurred, there would be a large increase in drilling activity. On the basis of this information, the assumption is made that there will be a 10% annual increase in oil and gas activity between 1979 and 1990.

It is assumed that access roads are an average 20 feet wide and 1 mile long, or that they occupy approximately 3 acres.

Projections

Geophysical Exploration

A total of 345 miles, or 520 acres of public land, were traversed in the resource area in 1980 for seismic work. At an increase of 10% per year between 1980 and 1990, 6,023 miles of seismic line work should be conducted on public land, or a total of 9,637 acres traversed.

Geophysical exploration causes minimal disturbance. If any major earthwork is permitted, it normally will be reclaimed within two years. The amount of disturbance would of course be directly related to the type of work done.

Leasing and Development of Federal Mineral Estate

The yearly average of oil and gas wells drilled in the resource area between 1970 and 1979 was 213, as shown in table 1-4. Because a large number of wells was drilled in 1979 on Naval Petroleum Reserve 3 in Natrona County, the 1978 figures have been used for that county (115 wells).

Table 1-3 lists the percentage of federal ownership of oil and gas estate by county. On the basis of these figures, the annual average number of wells drilled on federal mineral estate was 166. This figure will be used as a starting point to offset the abnormally large number of wells drilled on the naval petroleum reserve in 1979.

The actual increase in drilling per year between fiscal year (FY) 1978 and FY 1981 was 18.25%. The availability of drilling rigs and the increased depth of holes are limiting factors on the number of wells drilled. Because of these factors, to establish a reasonable estimate of wells being drilled at any given time, we will assume there will be a 10% annual increase.

On the basis of the above figures and assumptions, 3,550 wells will have been drilled on federal mineral estate by 1990—1,348 in Natrona County, 2,130 in Converse, 36 in Platte, and 36 in Goshen. At 5 acres per well (2 acres for location and 3 for access road), 17,750 acres will have been disturbed. The disturbance will occur primarily in Natrona and Converse counties.

The average rate of success for oil and gas wells between 1970 and 1979 was 61% for Natrona County, 75% for Converse County, 8% for Platte County, and 2% for Goshen County. Since the most easily discovered oil and gas has already been discovered, it is assumed that the success rate will decrease between 1979 and 1990; therefore, it is assumed that the success rate during that period will be 55% for Natrona County (a 6% decrease in discovery success) and 65% in Converse County (a 10% decrease in discovery success). The success rate will remain basically the same in Platte and Goshen counties because of the comparatively low levels of exploration there.

On the basis of the previous assumptions and for the purpose of analysis, it is therefore projected that 742 producing wells will be discovered in Natrona County, 1,384 in Converse, 3 in Platte, and 1 in Goshen, for a total of 2,130 producing wells in the PRA. The 10,650 acres associated with these producing wells would be under temporary reclamation measures by 1990.

Development of Private Minerals

Oil wells drilled on private mineral estate in the resource area averaged 48 per year between 1970 and 1979. As chapter 2 explains, a 10% annual increase in drilling is taking place on federal mineral estate, and it is assumed that there also will be a 10% annual increase in drilling on private land between 1979 and 1990. On the basis of these assumptions, it is projected that 1,026 wells will be drilled on private mineral estate between 1979 and 1990. Of these, 502 will be in Natrona County, 400 in Converse, 42 in Platte, and 82 in Goshen. The acreage disturbed will be 5,130, of which 4,510 will be in Natrona and Converse counties.

The average rates of success for wells in the counties between 1979 and 1990 were 61% for Natrona, 71% for Converse, 8% for Platte, and 2% for Goshen. As on federal estate, the most easily discovered oil and gas has already been discovered; therefore, it is assumed that the rate of success will decrease. Thus, it is assumed that the rate of discovery will be 55% in Natrona County and 65% in Converse County, and that the rates will remain the same in Platte and Goshen counties.

On the basis of the previous assumption, it is projected for the purpose of analysis that the number of producing wells discovered on private mineral estate over the next ten years will be 276 in Natrona County, 260 in Converse, 3 in Platte, and 2 in Goshen. This would leave 485 dry holes, or 2,425 acres reclaimed or in the process of reclamation by 1990. The 2,705 acres of surface associated with producing wells on private minerals should be under temporary reclamation measures.

Mineral material sales related to oil and gas activity will cause only a low intensity of surface disturbance; therefore, projections of future surface disturbance will not be made and its effects will not be analyzed.

Rights-of-Way

As of 1978, the BLM had authorized 280 rights-of-way on public lands in Natrona County and 25 in Converse County. The majority are used at least in part by oil and gas related industries. They are for electrical transmission lines, distribution lines, telephone lines, water pipelines, reservoirs, airstrips, mineral material sales, railroads, tank batteries, gas processing plants, bulk oil facilities, private roads, and state, county, or federal roads and highways. These lineal facilities involve 1,181 miles of rights-of-way on public land and a minimum of 4,265 acres (see MFPs for Natrona and Converse counties).

Since the amount of oil and gas activity in Platte and Goshen counties has been limited, it is expected that the amount of surface disturbance for rights-of-way related to the oil and gas industry would be insignificant. Table 1-4 shows the number of wells drilled and the number of dry holes in Platte and Goshen Counties in 1979. These figures reflect the activity over the past 10 years and the anticipated future activity.

Because the deregulation of oil and gas prices and the recent changes in right-of-way regulations make it difficult to estimate future right-of- way needs, estimates will not be made. Table 4-1 gives the acreage requirements and table 4-2 gives the water requirements for various oil and gas activities.

EFFECTS OF THE PROPOSED ACTION

Many of the impacts discussed in this section are those that can result from the use of poor tech-

TABLE 4-1
ACREAGE REQUIREMENTS FOR OIL AND GAS ACTIVITIES

Seismic exploration	1.6 acres per mile
Drilling/production location*	2.77 acres per
location	
0-10% slope	3.66 acres per
location	
11-24% slope	4.46 acres per
location	
25-39% slope	5.38 acres per
location	
40%+ slope	
Access road*	
0-10% slope	2.28 acres per mile
11-24% slope	3.12 acres per mile
25-39% slope	5.00 acres per mile
40%+ slope	8.68 acres per mile
Power line**	2.4 acres per mile
Pipeline**	2.4 acres per mile
Compressor station, gas plant, water disposal plant	5 acres per plant
Mineral material sale	3 acres per sale

Note: See Appendix A-2 for slope conversions.

* Derived from Megahan 1976. For access roads, the disturbance necessary to make a 16-foot wide driving surface.

** Assuming a 20-foot swath of disturbance within a 50-foot right-of-way.

TABLE 4-2
WATER REQUIREMENTS FOR OIL AND GAS ACTIVITIES

Drilling:	1 acre-foot per 3,000 feet of depth drilled.* Annual water usage for drilling is approximately 434 acre-feet** for wells drilled on federal oil and gas estate in the Platte Resource Area.
Production:	After the well is drilled, there is usually no water needed.

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* Personal communication, O.M. McCoy, Geological Survey, February 23, 1979.

** Average well depth in the resource area is 8,500 feet. If energy demand and oil prices warrant, the average depth could increase to 15,000 or 20,000 feet.

niques, violations of existing stipulations, or accidents.

An accurate prediction of oil and gas production during the term covered by this report is impossible because of changes brought about by the deregulation of oil prices. Drilling for oil and gas has increased and the success rate of wells is apparently high, and secondary and tertiary recovery methods are being initiated in numerous fields. All of these factors make projection of production rates difficult.

GENERAL IMPACTS

An unavoidable adverse impact would be that oil and gas produced and used would no longer be available for future use. Restrictions on oil and gas exploration and development hamper exploration efforts and lead to high prices for petroleum products.

The production and consumption of oil and gas constitutes an irreversible commitment of resources.

Restrictions on oil and gas activity through 1990 will limit new discoveries, leading to possible short supplies and higher prices over the long term.

EFFECTS ON PHYSICAL RESOURCES

Air Quality

Geophysical Exploration

Dust particles would be stirred up by increased vehicular travel on and off roads in the vicinity of geophysical operations. Gaseous emissions from gasoline and diesel powered engines also would be increased during the periods of operation. These pollutants would be localized in the vicinity of the activity and generally would not exceed state standards; therefore, they are considered insignificant.

Leasing and Development

Oil and gas activities affect air quality through the production of dust, vehicle emissions, and the emission of gases from petroleum products and hydrogen sulfide from wells. These emissions are usually restricted to the vicinity of the oil fields, transportation routes, refineries, and gas plants.

Impacts associated with dust and vehicle emissions would be similar to those that occur during geophysical operations. Gaseous emissions produced by most petroleum production and refinery operations are generally limited to the vicinity of the operation. Refineries in Casper process oil produced in the PRA; this results in the release of particulate and gaseous emissions over the city, which can be readily observed during periods of temperature inversion.

Under normal circumstances, the air quality in the PRA meets the standards; however, poisonous hydrogen sulfide gas has been known to be produced by some scattered wells in central Natrona County when certain limestone or dolomitic formations of Permian or older age have been penetrated. Hydrogen sulfide also is known to be produced in Niobrara County near the Converse County line. The emissions have been known to be produced in lethal quantities, resulting in a temporary, site-specific violation of Wyoming DEQ standards.

Hydrogen sulfide also is produced as a result of secondary oil recovery in the Salt Creek oil field, which surrounds the towns of Midwest and Edgerton in northeastern Natrona County. *The Salt Creek Hazardous Area of Critical Environmental Concern* (USDI, BLM 1980) discusses this situation in detail.

Rights-of-Way

Impacts associated with rights-of-way development would be similar to or slightly greater than those associated with geophysical exploration.

Impact Summary

Airborne dust and exhaust emissions would be the unavoidable adverse impacts of any surface disturbing activity. Other unavoidable adverse impacts can occur when certain formations are penetrated and poisonous hydrogen sulfide gas is emitted, resulting in hazardous conditions. Hydrogen sulfide gas also is a byproduct of certain oil field production practices.

No irreversible and irretrievable commitment of resources would be expected to occur from impacts on air quality.

Airborne dust and exhaust emissions would be present for the duration of the activity but would not have an effect on long-term productivity. Escaped hydrogen sulfide gas in lethal concentrations could destroy animal and human life in the vicinity of the source. The probability of this is high when drilling is done in certain formations in various parts of the resource area. This short-term impact would have a minimal effect on the long-term productivity.

Hydrogen sulfide gas as an irritant could have a long-term effect at the "nuisance" level. According to the Wyoming DEQ, nuisance levels are as follows:

> 70 micrograms of hydrogen sulfide per cubic meter, ½ hour average, not to exceed two occurrences per year, or
>
> 40 micrograms of hydrogen sulfide per cubic meter, ½ hour average, not to exceed two occurrences in any five consecutive days.

Water Resources

Geophysical Exploration

Surface Water. The impacts on surface water from gravitational, magnetic, and seismic exploration are primarily due to operation of vehicles and heavy equipment. Such impacts are minimal when these activities are confined to roads. When off-road operations are necessary, soil compaction, increased runoff, erosion, and consequent sedimentation are more severe. The most severe sedimentation results when graders and/or dozers are used to provide access to remote areas.

Groundwater. Drilling of shot holes for seismic surveys could contaminate alluvial aquifers, particularly if holes are not properly plugged after use. The probability of contamination is low under normal circumstances.

Leasing and Development

Surface Water. If a reserve pit leaks, ruptures, or overflows, drilling muds and production fluids can contaminate live water, in addition to killing vegetation and contaminating the soil. The materials stored in reserve pits typically contain toxic chemicals, brackish water, and oil. Their chemical constituents may include chlorides, chromates, hydrochloric acid, sodium hydroxide, and phosphates.

BLM field personnel estimate that 3 pits in 100 leak or break, although the incidence of spilled fluid reaching stock ponds or streams is less frequent. Most pit ruptures occur because the pit was constructed with inadequately compacted walls or was located in a drainage.

The effects of reserve pit breach of containment are both chemical and physical. Chemical pollution results from the direct contamination of water bodies and from contamination of soil, which may release materials slowly over long periods. Physical degradation of water quality can result from destruction of vegetation, which causes increased runoff and erosion and, consequently, increased levels of suspended sediment. These impacts can last for several years, until clean-up and reclamation are completed.

Oil spills are another impact associated with production. Oil spills generally occur when the oil is in transit, but they also can occur from blowouts during exploratory drilling and development. Oil entering a live water body can have a significant short-term effect, making the water unsuitable for domestic, wildlife, livestock, agricultural, and industrial uses. If unchecked, the impact from a spill could extend for miles throughout many drainages.

In 1981 BLM field personnel observed oil spills on well locations throughout the resource area. Regulations require reporting of spills to the EPA and the the Wyoming DEQ, and spills must be cleaned up. Detailed information on the requirements is available from the EPA and the DEQ. It is likely that some spills are not reported.

Produced water from oil fields is a source of significant amounts of dissolved substances. Produced water is defined as underground water that surfaces through oil and gas wells and is disposed of by reinjection, containment, or discharge after treatment for oil removal.

The temperature of produced water is frequently high, adding large amounts of heat to receiving waters. Elevated temperatures reduce the saturation concentration of dissolved oxygen. This reduces the suitability of the streams for sustaining fish populations and limits the stream's capacity for processing organic wastes. BLM personnel have observed temperatures as high as 35°C (95°F) in produced water discharges.

The Salt Creek drainage is an example of what can occur when leasing and development proceed with a minimum of environmental controls. Produced water discharges spot-checked by BLM field personnel in the Salt Creek Oil Field have had conductivities as high as 17,500 micromhos and TDS concentrations up to 13,210 mg/1. Chloride concentrations up to nearly 3,000 mg/1 have been reported. The highest observed oil and grease level was 46.1 mg/1. Laboratory analyses are on file in the Casper District office.

The values listed above all exceed the maximum permissible levels established by the Wyoming DEQ. Even discharges that are in compliance with effluent limitations can have a significant adverse impact on receiving waters, especially during times of low flow, when dilution effects are minimized. The Salt Creek drainage is discussed in detail in the *Salt Creek Hazardous Area of Critical Environmental Concern*.

Groundwater. There is a potential for oil and gas development to pollute groundwater. Shallow alluvial aquifers at depths of less than 100 feet are susceptible to contamination from the surface if surface spills of oil or toxic substances percolate downward to the water table. This could render the waters unsuitable for domestic and livestock use, depending on the extent and severity of the pollution.

Deeper aquifers can be contaminated during drilling operations. The quality of water in each formation varies; a freshwater formation may exist above or below a briny water formation. If drill hole casings are not properly cemented, mixing of water from different aquifers can degrade high quality groundwater. Infiltration of drilling fluids also can degrade local water quality, resulting in some cases in the pollution of supplies for a municipality such as Douglas, which obtains its water from the Madison Formation.

Injection of water during secondary oil recovery can cause degradation of groundwater quality. If the injection well casing is inadequately cemented, water flowing back up around the outside of the casing will contaminate any aquifer through which it passes.

Regulations require that drill hole casing be cemented in place to a depth of at least 150 feet or more, if necessary, to prevent mingling of aquifers and contamination by toxic materials. Failures, or leaks, occur in 0.5% to 1% of the wells drilled (*Buffalo Resource Area Oil and Gas Environmental Assessment*, USDI, BLM 1978). Usually the amount of drilling fluid or brackish water that infiltrates the aquifer(s) is small and greatly diluted by mixing in the aquifer; therefore, no significant impact ordinarily occurs.

Fracturing the rock in the oil-producing zone is often part of developing a well. This process consists of opening up small fractures in the producing rock and pumping sand into them. The process aids in directing the flow of oil to the well bore hole, thus locally increasing the permeability of the rock. Improper fracturing is another potential source of interformation contamination.

Very little accurate information is available on long-term changes in groundwater quality associated with existing oil and gas development in the PRA; therefore, quantitative projections of the impacts of future developments are not reliable. It is likely that adverse impacts on groundwater quality will be highly localized and result mostly from isolated incidents such as spills and reserve pit ruptures.

Rights-of-Way

Both surface water and groundwater may be contaminated during right-of-way construction, maintenance, and operation, when there is a high potential for surface disturbance, erosion, and sedimentation. The greatest hazard to surface water quality occurs during construction of pipelines and roads, particularly when drainages must be crossed, because of the extent and depth of surface disturbance. When properly applied, the standard stipulations applicable to right-of-way construction provide moderately effective to highly effective mitigation; nevertheless, the residual impacts of a road network and associated vehicular traffic can be expected to increase sediment yields above background levels.

Oil spills, another impact associated with rights-of-way, most frequently occur when oil is in transit. When pipeline construction, maintenance, and operation comply with federal safety standards for liquid pipelines, the probability of accidental spills is minimized; however, the possibility of leaks, spills, and ruptures cannot be eliminated. The impacts of oil spills are discussed in more detail under "Leasing and Development."

Impact Summary

Among the unavoidable adverse impacts on water resources is the cumulative surface disturbance associated with geophysical exploration, well site development, and right-of-way development, which would contribute to higher levels of erosion, runoff, and the consequent sedimentation of surface waters. The discharge of produced water from an increasing number of wells and treater facilities would cause an increase in the concentrations of dissolved solids in surface water, another unavoidable impact.

The probability of accidental spills of oil and toxic substances would increase with increased oil and gas activity, thereby increasing the probability of contamination of surface water and groundwater. Another unavoidable adverse impact would be the interformation groundwater contamination and leakage of toxic substances into shallow aquifers that could occur in spite of the application of standard surface protection measures (0.5% to 1% of wells drilled). This impact could render some shallow wells unsuitable for domestic and livestock use.

Excessive sedimentation could cause irretrievable changes in aquatic habitat if stream channels, lakes, marshes, or reservoirs became filled with sediment. These habitats then would no longer be capable of producing the former quantities of fish unless sediment was physically removed, a practice generally considered impractical.

The most severe surface water sediment loads would occur during the initial stages of exploration and development, a short-term effect. Lower levels of sediment pollution would continue until production ceased and disturbed areas were revegetated and stabilized. Dissolved substances from produced water would continue to be discharged until production ended. Toxic substances in drainages could pollute natural runoff for a long time.

Some soils that became heavily oil-soaked or eroded away would represent irreversible losses. Groundwater aquifers could suffer permanent loss of water quality through contamination by pollutants.

Topography

Geophysical Exploration

Geophysical operations increase the potential for gully erosion, especially during wet periods. Off-road vehicle travel can cause ruts in which water will wash and flow, causing erosion on sloping terrain. Gullies would develop over time and, unless stabilized, would result in modification of the topography.

Slope modification (dirt work) is required from time to time to provide access to steeper slopes. If these areas were not properly stabilized, erosion would be likely to occur. It could be impossible to return the disturbed areas of steeper slopes to the original topography. Approximately 1.6 acres are traversed for each 1 mile of exploration. As slope increases, the amount of disturbance increases. On this basis, approximately 9,637 acres within the resource area would be traversed during seismic operation over the ten-year period; however, this disturbance generally has not been a significant adverse impact.

Shot holes can cave in if not properly plugged and capped, resulting in depressions in the soil and creating a safety hazard. Field observations indicate approximately 2 holes out of each 100 holes drilled are left unplugged. This can result in modification of slope and depressions in the soil.

Leasing and Development

When steep slopes are disturbed, the land tends to slide or slump. Slumps increase the amount of surface disturbance that occurs. The steeper the slope, the greater the possibility of gully erosion, the risk of oil spills, and the possibility of pipelines breaking or of tanks and treaters toppling.

Some areas where slumping has occured as a result of oil and gas activity are Pine Ridge, Salt Creek Oil Field, Burnt Wagon Oil Field, and South Casper Creek Oil Field. Natural slumping occurs in Bates Hole and the South Fork Powder River drainage; consequently, it is expected that slumping potential would be high here, as it is in the mountainous areas discussed in chapter 3. Oil and chemical spills can destroy vegetation, and if spills get into streams they destroy aquatic flora and fauna.

As slope increases, the area disturbed for well site and road construction increases. No statistics are available on the number of well locations of various degrees of slope, so it is impossible to determine the exact amount of disturbance that would occur; however, it has been assumed that approximately 5 acres will be disturbed for each well site and associated access road. On the basis of that assumption, it appears that 17,750 acres will have undergone some sort of modification by 1990. Approximately 10,650 acres should be partially reclaimed, and the remaining 7,100 acres would be totally reclaimed within the ten-year period.

Rights-of-Way

Right-of-way development usually results in the alteration of the landscape character to a certain extent, depending on the type of right-of-way. Trenches that are constructed for cables and pipelines, if not properly protected, can result in gully erosion. Slope modification may also be required for crossing drainages and ridges. Construction of access roads also results in a modification of the topography. The amount of disturbance depends on the percent of the slope being crossed.

Impact Summary

Soil erosion that would occur would result in an unavoidable modification to the topography, regardless of reclamation techniques used. The local impact from this change would be significant; where the slope modification occurs, it is impossible to return the area to its original topography. As slope increases, the task of slope approximation becomes increasingly difficult.

Where surface disturbance occurs, some soil would be irretrievably lost through erosion, and the character of that topography would be irreplaceable on those sites.

Surface disturbance and related alterations to topography would occur until vegetation became reestablished, particularly on the 17,750 acres that will undergo some topographical changes at various stages of reclamation.

Soils

Geophysical Exploration

Any disturbance to the soil or vegetative cover results in increased erosion. Soil becomes compacted and vegetation is crushed during geophysical exploration. The amount of soil compaction depends on the soil moisture content; however, the amount of soil disturbance and the distance of sediment transport is minimal with little or no effect on the productivity of the land.

More effects occur at drainage crossings, where drainage side slopes may be cut in order to facilitate equipment crossing. The surface is smoothed out and the soils mixed. Small sediment sources are created, but they are limited in activity and extent. The current oil and gas stipulations are effective in mitigating these impacts. About 9,637 acres would be affected during geophysical exploration.

Leasing and Development

The pedology of the soils would be drastically affected on the 17,750 acres expected to be disturbed during leasing and development. On the pad site, the topsoil is removed and unavoidably mixed when stockpiled. Mixing may be particularly critical on areas of shallow soils. If the topsoil is mixed with underlying materials unsuitable for plant growth, the resulting combination is often less productive than the original topsoil. This increases the difficulty of reclamation. Approximately 54% of the PRA is characterized as having some amount of shallow soil components (see chapter 3); therefore, impacts resulting from soil mixing on disturbed sites would be significant where these components occur.

Soil contamination can result if spills of petroleum products, bentonite, drilling muds, or poor quality water occur. For this reason the integrity of the reserve pit is a particularly critical concern. Leakage from the reserve pit can seriously retard the reclamation potential of the affected area, both on site and downslope.

Another impact would be compaction of the soil surface after removal of topsoil. Compaction is caused by the movement of vehicles and equipment over the soil surface, and it results in a reduction in water infiltration and soil permeability. Root growth of plants may also be excluded from this zone during reclamation.

These effects also occur along the access route to the pad site. Since earthwork should be minimal, compaction of the topsoil is the major soil-disturbing factor. Approximately 85% of the PRA has fine loamy or fine-textured soil components. Impacts from compaction would be greatest on these soils.

When the protective vegetative cover is removed, soil materials are particularly susceptible to erosion. This applies to the stockpiled topsoil, to the drill pad site, and to a lesser extent, to the access route.

Regardless of the form of soil disturbance, the major impacts to the soil resource would be loss of soil productivity and increased erosion. These two impacts are intrinsically related. Restoration of soil productivity is not possible under conditions of erosion above predisturbance levels. Furthermore, accelerated erosion can have many offsite effects. Numerous sediment sources can be created along drainage ways. Offsite soil productivity can be reduced through burial by onsite derived sediment. Onsite runoff channels can create hills and gullies downslope.

Poor reserve pit construction techniques have resulted in leakage and rupture on many occassions. Other impacts are effectively mitigated by stipulations now being applied at the time of the APD.

Leakage from the reserve pits has been documented on an average of 3% of sites. This leakage contaminates the soil and hinders reclamation. Leakage has occurred when pits were constructed from porous soil materials with high sand content, which has a fast permeability rate. Other pits have leaked through dikes that were constructed during the winter, because snow and ice mixed with soil during construction have melted when warmer weather arrived. The melting of snow and ice resulted in reduced compaction, increased permeability, and subsequent leakage.

Rights-of-Way

The impacts of rights-of-way vary according to the kind of activity asociated with the right-of-way. Overhead utility lines have minimal effects on the soil resource. Soil is destroyed where poles are erected. Other impacts due to overhead utility lines would be similar to those impacts described for geophysical exploration. These impacts are mitigated by the standard stipulations.

The establishment of underground pipelines results in the removal and subsequent mixing of the soil materials. When topsoil becomes mixed with the less productive underlying materials, the overall reclamation potential of the topsoil is reduced. Compaction of the soil occurs along the pipeline route from vehicle and equipment traffic. The effects of compaction from limited traffic are negligible, and the current stipulations effectively mitigate these impacts.

The impacts from the remaining right-of-way activities such as roads, oil facilities, and production pits are similar to those discussed under "Leasing and Development." The current stipulations have been effective in mitigating these impacts; however, the amount of overall soil disturbance has been greater than necesary. More than one access road is often made into a facility. This contributes to the problems associated with accelerated erosion and site reclamation.

Impact Summary

A residual unavoidable impact on soils would be the alteration of existing soil characteristics and properties. Vegetation would be lost until reclamation and revegetation were completed.

Soil loss resulting from disturbance and subsequent erosion is considered irretrievable. The disturbance of natural soil profiles and the different associated vegetation types can be irreversible.

Soils will not be productive over the short term. Following reclamation, the kind and amount of vegetative cover would be different from the predisturbed state. The fact that there was soil disturbance at a particular location will always be recognized by the trained observer. The loss of soil through erosion would be permanent. Another long-term impact would be the destruction of the natural soil profile.

EFFECTS ON BIOLOGICAL RESOURCES

Vegetation

Terrestrial Plants

Geophysical Exploration. The impacts of exploration on terrestrial plants could be significant where the surface disturbance would cause vegetation to be temporarily lost or destroyed. Past field observations indicate disturbance could vary from 0 to 2% of the total length of lines run. This depends upon the amount of off-road travel, the time of year, and the topography. Disturbance can be caused by drilling shot holes, upgrading roads, and improving drainage crossings.

Of the total work to be done through 1990, 1% would traverse 60 miles, or 96 acres; 2% would disturb 120 miles, or 193 acres. This disturbance would be primarily in the 10-inch to 14-inch precipitation zone of the Northern Plains, where a high amount of oil and gas activity is occurring (see table 3-8).

Leasing and Development. All vegetation would be temporarily lost on 17,750 acres by 1990. This loss would occur primarily in the sagebrush-grass vegetative type. Assuming that it will take five years to restore the vegetative cover to full growth, approximately 2,490 acres would be in some stage of rehabilitation by 1990.

Dust from hauling on access roads would temporarily reduce usable livestock forage by affecting palatibility. Accidental spills of oil, salt water, and chemicals would be expected to destroy or hamper vegetative growth temporarily. It is impossible to predict where spills would occur and whether the loss of vegetation would be significant; past losses have been insignificant. Minor spills that can be readily cleaned up occur several times a year; major spills occur less than once a year.

Site-specific rehabilitation procedures, although followed by the industry, will fail on some sites, causing them to be exposed to soil erosion and encroachment by weeds for ten or more years. This could happen on up to 1% of all predicted holes to be drilled, resulting in approximately 75 acres being affected. Failures can result from livestock abuse, soil pollution, or natural high salt content in the soils.

Approximately 80% of the 1% failure is due to livestock abuse, which could be corrected by fencing. Soil pollution, which accounts for approximately 15% of the failure, could be corrected by better practices of handling fluids. The remaining 5% of failures resulting from salts could be corrected by taking soil samples before reseeding is done.

Vegetation on rehabilitated sites would be of a different quantity and quality than that on the original site. There would be fewer native species; native shrubs would not be successfully reestablished in the short term to the extent that they were present before surface disturbance. This could cause impacts to wildlife as well as visual impacts.

On the basis of a 60% success rate for wells drilled, vegetation loss would occur on 10,650 acres by 1990.

Rights-of-Way. Impacts from rights-of-way would be similar to those from leasing and development. The most serious impact to vegetation would be that from the soil disturbance that takes place when the right-of-way is bladed. In many cases more soil is disturbed than is necessary for installation and maintenance of the project. This results in excessive vegetative losses.

Aquatic Plants

Geophysical Exploration. Increased sediment loads in streams could occur during exploration when equipment crosses live water or dirt work takes place in or near streams or boggy areas. Some aquatic vegetation would be destroyed by construction activities, but in most cases the impacts of exploration on aquatic vegetation would be insignificant.

Leasing and Development. In most cases, aquatic areas can be avoided in the location of drill pads. Most impacts during development would come from road construction and spills. The overall effect on aquatic plants has been negligible; it usually can be anticipated and mitigated.

Rights-of-Way. Impacts on aquatic plants from rights-of-way would be the same as those described for exploration and for leasing and development.

There are no plants in the resource area that are listed or proposed for listing as threatened or endangered.

Impact Summary

Vegetation on more than 7,100 acres would be temporarily lost by 1990, but one-half to two-thirds of this would be successfully rehabilitated during that period. A unavoidable long-term loss of vegetation would occur on all producing sites for more than 30 years. More than 10,650 acres would be affected.

Spills of oil, salt water, or chemicals would cause the temporary loss of an undetermined amount of vegetation.

A small percentage of disturbed ground would never be reclaimed. This irretrievable loss would be caused by poor planning, poor site construction, operator failure to do work properly, or weather conditions. Since less than 5% of the total acreage would be affected by all phases of development, fewer than 800 acres would be affected by 1990.

Oil and gas activity resulting in nonproductive sites would not have a significant long-term effect on vegetation, but producing sites would result in the long-term loss of vegetative production and vegetative cover on approximately 10,650 acres.

Wildlife

Geophysical Exploration

The primary impact of geophysical exploration on terrestrial animals would be disturbance. The building of roads would result in the destruction of foods and cover and in the degradation of water quality, so that habitat would be affected.

Impacts on wildlife populations from a dispersed activity such as oil and gas exploration vary with conditions. If a population is distributed over a large portion of the resource area, then impacts are unlikely to be regionally significant; however, any wildlife species that is restricted to a specialized or uncommon habitat can be significantly affected by surface disturbance in that habitat. Examples of species in specialized habitat are elk, raptors, and some game birds.

Of all big game in the resource area, elk are the most sensitive to, and intolerant of, human presence and human-caused disturbance. Construction and upgrading of access roads would have the greatest impact on elk, because it would open to human use feeding areas and escape cover areas that were formerly sanctuaries.

Two studies in Idaho indicated that human access into previously undisturbed habitat resulted in a higher legal harvest and led to long-term declines in elk populations (Thiessen 1976, Leege 1974). Hershey and Leege (1976) found elk use of habitat was disrupted within ¼ mile on either side of logging roads in Idaho. Ward (1976) found the same was true of elk in southeastern Wyoming. Coggins (1976) said high road densities and heavy traffic excluded elk from any areas of escape cover. Perry and Overly (1976) found a significant drop in habitat use near roads compared to similar habitats in undisturbed areas. The studies mentioned concluded that construction of roads in elk habitat might not leave enough buffer area between the roads and escape cover.

Maintaining undisturbed winter habitat is critical to maintaining the elk herds. Human presence, traffic, and ORV use could cause elk to leave these winter ranges. Displacement to areas of sparse cover and forage, higher elevations, deeper snow, and greater exposure to wind would cause death and result in lesser populations. The opening of, or improvement of, access roads in these ranges provides the means for human disturbance during the critical winter season.

The elk calving season (May and June) is another period when disturbance can drive elk to areas of poor cover, reducing the survival rates of the calves.

Mule deer are less sensitive to disturbance than elk, but they are vulnerable to disturbance occurring on their winter ranges. Traffic, noise, and human harassment could cause deer to leave their winter ranges where food and shelter are available. However, since deer winter use in a particular area depends on snow depth and exposure, adverse impacts would vary depending on the severity of the winter.

Pronghorn tend to be the most adaptable of big game animals, but they are especially susceptible to disturbance when they are restricted to the small areas which meet their needs during the critical winter season.

Restrictions on oil and gas activity that are discussed in chapter 2 would be continued within critical seasonal habitats. These habitats are listed in table 4-3.

Sage grouse are the most common upland game bird in the PRA. They conduct their mating activities on the same leks (strutting grounds) every year (see Map 2 in Appendix 9). It is estimated that 80% to 87% of sage grouse nesting occurs within 2 miles of the leks (Wallestad 1975). Because the birds are concentrated at leks, they are highly vulnerable. Surface disturbance, harassment, and poaching can have significant effects on sage grouse populations. The current statewide stipulation restricts surface occupancy for ¼ mile around leks year-round and for an additional 1¾ miles (a total of 2 miles) during the breeding season. Sage grouse nesting outside the 2-mile buffer zone (less than 20% of the population) could still be affected. This probably is not a significant problem; however, not all leks have been discovered, and the impacts to birds strutting at these unidentified leks and nesting around them are not known.

URAs for this area contain lists of raptors found here. Known raptor nesting areas are shown on Map 2 Appendix 9. The favored nesting habitats for raptors are solitary trees in ephemeral stream beds, and cliffs. The nesting season generally is the time of highest physiological stress for raptors. Even a one-time disturbance can cause the more sensitive species (eagles; hawks, especially the ferruginous and Swainson's; and the short-eared owl) to abandon their nests, especially during egg-laying and incubation. Because raptor nests are built in exposed locations, the birds can see and may be disturbed by activity as far away as ½ mile.

Current land use decisions protect nesting raptors by prohibiting surface disturbance for oil and gas activities seasonally within a buffer zone around active nests, so that most adverse impacts are averted.

Species in the PRA that are listed as endangered by the U.S. Fish and Wildlife Service (USFWS) are the black-footed ferrret, the bald eagle, and the peregrine falcon. The Endangered Species Act of 1973 requires consultation with the USFWS before an action can be authorized that could affect an endangered species or its habitat. The BLM formally consults with the USFWS on a case-by-case basis when a situation is identified that may have such an effect.

Bald eagles are common winter residents in the resource area, usually arriving in late October or November and leaving in March or early April. The arrival and departure dates are strongly dependent upon the weather. The eagles use the North Platte River and reservoirs and range freely across the plains in search of carrion and small mammals.

Eagles concentrate in night roosts, usually in secluded canyons. The two most important characteristics of the communal roost sites are solitude and protection from the weather. Disturbance near bald eagle roosts and favored feeding areas would probably cause the eagles to abandon the areas. Other suitable sites may or may not be present in the same general area. Since winter is a time of high physiological stress, some birds could be lost if they were forced to relocate in less favorable habitat. Seasonal restrictions on geophysical exploration protect 29,000 acres of upland bald eagle habitat and 90 miles along the North Platte River (see Map 2 in Appendix 9).

Vehicles operated for geophysical exploration in black-footed ferret habitat (essentially, prairie dog towns) may run over ferrets, or the animals may be killed in drilling shot holes. Although these are unlikely events, the very rare occurrence of ferrets makes each animal extremely important.

Peregrine falcons are seen in the area only occasionally; therefore, any adverse impact of oil and gas activity on peregrine falcons would be unlikely.

Leasing and Development

Impacts on terrestrial wildlife from leasing and development would be similar to those from geophysical exploration, except that development would destroy more habitat. As explained in the section on geophysical exploration, elk are the most sensitive big game species; maintenance of elk herds at present population levels can be achieved only if disturbances in critical winter ranges are restricted. Present stipulations do not provide for this, as drilling already begun may be continued through the restricted season. Mainte-

TABLE 4-3
CRITICAL WILDLIFE HABITATS
NEEDING SEASONAL RESTRICTIONS ON OIL AND GAS ACTIVITY

	Proposed Action	Alternative 2
Elk critical winter range	13,000 acres	17,500 acres
Deer critical winter range	650,000 acres	400,000 acres
Antelope critical winter range	350,000 acres	350,000 acres
Sage grouse strutting/nesting area	33	33
Raptor nests	58	58
Prairie dog towns (potential black-footed ferret habitat)	4,600 acres	4,600 acres
Bald eagle roosts	29,000 acres	29,000 acres
Bald eagle habitat--North Platte River	90 miles	90 miles

nance and operation also would continue through the winter on producing wells.

Elk habitat identified by the Wyoming Game and Fish Department as critical for maintenance of the herds is shown on Map 2 in Appendix 9. The greatest impacts to elk from oil and gas development would occur in the Rattlesnake Mountains, on Muddy Mountain, and in the extreme southern part of Converse County.

The construction of drill pads, roads, pumping stations, and communication sites removes all cover for wildlife. This cover is lost for the duration of the development. An estimated 17,750 acres in the resource area will have been disturbed by oil and gas activities by 1990. Reclamation will have been completed on 4,970 acres, or 28% of the land disturbed, but the reclaimed areas will not be suitable for wildlife requiring shrubs or trees for food and cover.

Replacement of wildlife habitat will take many years; for example, in areas where sagebrush is a major component of the vegetation, the loss of brushy cover will last for 30 years or more after site rehabilitation is completed (University of Wyoming 1976). Loss of wildlife habitat is expected to occur primarily in the sagebrush-grass vegetative type. The 17,750-acre loss would represent 0.3% of the total sagebrush-grass type in the resource area.

Loss of habitat means a corresponding loss in carrying capacity (the ability of the land to support wildlife). For wildlife species characteristic of the sagebrush-grassland habitat, the carrying capacity of the resource area would be reduced by approximately 120 pronghorn, 80 mule deer, and literally thousands of small mammals, birds, reptiles, and amphibians. Wildlife densities, on which these numbers are based, are given in the *Final Environmental Statement on Proposed Development of Coal Resources in Eastern Powder River, Wyoming* (USDI, BLM 1979). In addition, traffic, noise, and human activity on disturbed areas harass wildlife on adjacent undisturbed land.

Disturbance of sage grouse from leasing and development would be similar to that caused by geophysical exploration. Destruction of sage grouse food and cover would be the same as that for big game.

The following impacts would not be mitigated by the statewide stipulations restrictng surface occupancy to a total of 2 miles from leks:

> Nesting habitat ¼ mile to 2 miles from leks could be destroyed during the nonbreeding season.
>
> Wells drilled between ¼ mile from leks and 2 miles from leks during times when only the ¼ mile limit applies could, if producing, affect strutting and nesting birds during the breeding season.
>
> Birds (20% of the population) and nesting habitat outside the 2-mile buffer zone could be destroyed at any time.
>
> Birds and nesting habitat at leks not yet identified could be destroyed.

Neither the number of leks still undiscovered nor the locations of development are known; thus, the significance of these unmitigated impacts cannot be estimated.

Significant impacts to wild turkey habitat would be destruction of foods and cover. Since foods critical to survival of turkeys are found along drainages and in croplands, little actual impact would be likely to occur. Existing stipulations restrict oil and gas activity in these areas, and trees used in roosting and as escape cover are also protected under existing stipulations.

Impacts to raptors during leasing and development would be the same as those from geophysical exploration.

Impacts to bald eagles during leasing and development also would be similar to those described for geophysical exploration. In addition, trees might be removed that eagles use as perch sites during feeding and resting or as thermal cover in overnight roosting. This would make the sites useless for eagles and would constitute a long-term impact. Other sites may not be available to meet bald eagle needs during the winter.

Although existing stipulations restrict surface occupancy during winter, a well begun before winter could continue drilling through this critical season. Maintenance and operation of producing wells also would be permitted during winter when drilling occurred during the noncritical season. Either of these situations would be likely to cause eagles to abandon the habitat.

Habitat for another endangered species, the black-footed ferret, cannot be destroyed until a biological assessment has been carried out and consultation with the USFWS determines that the affected portion of the habitat is not critical to survival of the species. Consultation procedures are discussed under "Geophysical Exploration."

Important aquatic wildlife habitat is present in the Laramie Peak Range, where steep canyon slopes contribute to the problem of sedimentation. Steep slopes are difficult to reclaim, especially in mountainous areas where the short growing season prolongs the revegetation process.

If roads and other disturbed areas are not completely reclaimed, erosion is certain and the potential for gully formation is high. Both of these conditions would increase soil erosion and subsequent silt loads in streams. This would reduce light penetration, which in turn would reduce productivity of aquatic plants. Aquatic plants could be scoured from their substrate by excessive silt loads; this reduces invertebrate populations. Increased silt loads in streams would clog spawning gravels and suffocate eggs of trout and other gravel-spawning fish. Silt loads also can clog gills, causing death of fish.

Spills of toxic substances such as crude oil and production fluids can degrade water quality for varying periods, depending on the amount and toxicity of the particular contaminant. Direct mortality of fish, aquatic invertebrates, and aquatic plants could result from spills of crude oil that reach streams and reservoirs. Crude oil spills also could cause long-term contamination, as an oil-soaked stream bed would be the source of continuous release of oil into the stream for a long time. Spills of toxic fluids also could render streams unfit as wildlife water sources.

Restrictions of no surface occupancy within ¼ mile of the North Platte River or within 500 feet of perennial streams would be continued under this alternative; hence, impacts are expected to be slight.

Rights-of-Way

Impacts on big game, sage grouse, raptors, and threatened and endangered species from rights-of-way would be similar to those discussed for geophysical exploration and for leasing and development. Destruction of big game habitat even in summer could have a significant impact on herd survival. Impacts on aquatic wildlife from rights-of-way also would be similar to those discussed for geophysical exploration and for leasing and development.

Impact Summary

Losses of big game carrying capacity and of habitats for bald eagles and sage grouse would be unavoidable. Destruction of the habitats of elk and bald eagles would be irreversible and would result in lower populations of these species.

Long-term effects of the proposed action would be reduction of the resource area's carrying capacity by approximately 120 pronghorns and 80 deer for up to 30 years. This is less than 1% of the regional populations. Long-term destruction of 17,500 acres of critical winter range for elk also would be possible under the proposed action.

Destruction of sage grouse habitat for up to 30 years would be likely under the proposed action. The removal of trees by oil and gas activity would be restricted on 180,000 acres of turkey habitat. This restriction is needed on only 14,000 acres.

Upland roost and perch areas for bald eagles would not be protected on 29,000 acres, and it could take more than 80 years to reestablish mature trees. It is likely that eagles would abandon these areas if they were disturbed, and the wintering population would be affected significantly.

EFFECTS ON OTHER FEATURES

Cultural Resources

Geophysical Exploration

The disturbance of site features, crushing of artifacts, and compression and displacement of near-surface deposits would occur during geophysical activities. Additional surface disturbance may result from support vehicles, which initiate new trails and which may encourage recreational off-road vehicle travel.

There also is a possibility that seismic shot holes could be drilled through buried sites, causing damage. While such impacts are usually minimal, increasing seismic activities in areas of high cultural site density increases the probability of more serious impacts in the future to unidentified sites that could be eligible for the National Register.

A beneficial impact might be the discovery of a previously unknown significant cultural site by the geophysical crew, if the discovery was reported to the BLM, so that the site could be identified and evaluated. This would add to the cultural resource data base.

Leasing and Development

Beneficial consequences should result from continuing to issue leases subject to conditions and stipulations identified in MFPs and in federal cultural resource laws. Standard stipulations allow the BLM and the State Historic Preservation Officer (SHPO) to give due consideration to the identification and evaluation of the significance of cultural resources (including their potential for National Register eligibility); the type and degree of potential impacts; and suitable mitigative measures such as data recordation, site preservation and protection, and management. Therefore, potential impacts would be adequately mitigated under the proposed action. Overall, more data would be compiled through stipulated field inventories than would be lost through site destruction.

Rights-of-Way

Adverse impacts on cultural resources from rights-of-way would be effectively mitigated under the proposed action in the same way as impacts from leasing and development. Beneficial impacts also could be expected to occur because the data collected on cultural resources found during oil and gas activity would be added to the cultural data base.

Impact Summary

Unavoidable adverse impacts would result from the occasional destruction of cultural sites by off-road vehicle travel and earth movement and by unauthorized collection of artifacts occurring on the surface, which would result in the loss of data.

Any loss of information would be irreversible and irretrievable. The significance of such loss is unknown, but it is presumed to be low.

Because known important cultural sites are scarce in the resource area, the short-term oil and gas activity should not result in a significant loss of important information.

Visual Resources

Impacts to the visual resource result from constructed additions to, or alterations of, the natural landscape. Structures such as power lines, pumpjacks, and scars made by roads are intrusions; the degree of impact depends upon their contrast with the natural landscape. The measurement of impacts is based upon the ability or inability to see an impact rather than upon aesthetics.

Geophysical Exploration

The surface disturbance along an estimated 6,023 miles of seismic line work, or a total of 9,637 acres expected to be traversed by 1990 (see chapter 1) would cause some adverse impacts to the visual resource. Increased erosion, loss of vegetative cover, and establishment of two-way trails probably would result from exploratory activities. The seriousness of the impacts would depend on the location of exploratory activities, the season or degree of cross-county travel, and the success of rehabilitation.

A "worst-case" situation would be the clearing of heavy vegetation resulting in contrasting patterns on the terrain, especially in heavy brush or timber. Long-term impacts would result from such activity. If any impact occurred to a degree that the line, room, or color of an area would be altered or scenic quality would be reduced, there would be at least a temporary change in the area's management class.

Leasing and Development

Oil and gas activity is expected to cause changes in the natural landscape over approximately 17,750 acres by 1990. This could result in a reduction of scenic quality and a change in management class. For example, the grouping of pumpjacks or the establishment of a network of access routes would temporarily change the VRM class in the vicinity of the development to Class V (intrusion). Once a well was abandoned, the surface reclaimed, and the vegetation restored, the area would revert to its original VRM class. If the abandoned well was not adequately rehabilitated or if accumulations of litter and derelict equipment were left, adverse visual impacts would continue.

Most areas affected would be scenic quality Class C, with some Class B and some areas that would be designated VRM Class III (see map 3 in Appendix 9). The locations most sensitive to the reduction in scenic quality would be areas along high use roadways, recreation areas, and areas near population centers.

Rights-of-Way

The main sources of visual contrast to land and vegetation often are those that result from clearing and grading; many of these are access roads. If a network of access routes happens to be in flat or rolling terrain, the roads are highly visible and their impact is significant.

Impact Summary

A decrease in VRM classes in developing areas would be an unavoidable impact. No irreversible and irretrievable commitments of resources have been identified.

Short-term or long-term changes in visual contrasts would be created by access roads, power lines, and facility structures. Whether a short-term or a long-term impact occurred would depend on the duration of the activity and the success of rehabilitation.

Noise Conditions

Oil and gas development increases noise levels. Noise produced by equipment constructing roads, drilling wells, or pumping oil not only is annoying (table 3-13) but may exceed standards set by the Occupational Safety and Health Administration for exposure to noise (table 4-4). The change in noise level is most noticeable in rural areas where the primary noise source is the wind, but noise may be most objectionable in or near residential areas.

Geophysical Exploration

An increase in noise level—90 to 112 dB(A) as compared to 30 to 80 dB(A)—would occur during the period of seismic activity. This could disrupt the activities of wildlife and domestic animals.

Leasing and Development

Although the increases in noise levels in producing oil fields are of longer duration than those of geophysical exploration, the impact of these noises on wildlife and domestic animals would be similar to that of noises occurring during seismic activity.

Oil fields near communities or housing units would constitute a nuisance to the inhabitants. The impacts from electrified fields would be less severe than those from other oil fields.

Rights-of-Way

The impacts resulting from right-of-way construction would be similar to those associated with geophysical exploration.

Impact Summary

Increases in noise levels that affect human and animal life would be unavoidable adverse impacts. No irreversible and irretrievable commitment of resources has been identified.

Increases in noise levels would continue for the duration of the activity. As activities ended, noise levels would return to normal.

EFFECTS ON VARIOUS LAND USES

Residential Areas

The development of oil and gas resources in or near residential areas presents special problems, particularly those related to aesthetics and public safety. Residential land quality is affected by the presence of an oil field: dust and objectionable odors drift into residential areas, the noise of internal combustion engines is objectionable, and oil production facilities are eyesores. Safety hazards include additional traffic (some oversize or carrying crude oil) on residential streets, the potential for explosions and fires, and danger to children and pets from heavy machinery and mud pits.

Conflicts between residential use and oil and gas development occur in two ways. First, although 43 CFR 3101 prohibits leasing within incorporated cities, towns, and villages, the law cannot control the growth of cities over leases issued years ago. Second, leases can be issued and developed beneath existing unincorporated residential areas on the outskirts of cities. This is happening around Casper and could occur around Glenrock, Douglas, and other cities in the resource area.

An increase in trucks and heavy equipment associated with oil and gas operations causes road deterioration. This is an unavoidable adverse impact in residential areas. Noise from engines powering drilling rigs or pumpjacks is another unavoidable adverse impact, as is the danger to persons and animals from moving parts and equipment associated with drilling and pumping.

Fenced trash pits do not always prevent trash from blowing, and open water or oil-filled pits can be hazardous to persons and animals and can become breeding areas for pests as well as being unsightly.

No irreversible or irretrievable commitments of resources have been identified.

Nonproducing sites would have no long-term impact on residential areas. Producing wells would make those locations undesirable for residential development for the life of the well, which could be 30 to 50 years or longer.

TABLE 4-4
STANDARDS FOR OCCUPATIONAL EXPOSURE TO NOISE

Duration of Exposures per day (Hours)	Maximum Sound Level [dB(A)]
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

Source: U.S. Department of Interior, Fish and Wildlife Service 1978.

Ranching

Geophysical Exploration

Seismographic exploration can affect ranching operations in a variety of ways. The biggest problems are caused by fence damage or by gates being left open by seismic crews, causing livestock to drift and mix with neighboring herds. Heavy trucks and equipment may cause damage to existing cattleguards. Noise from explosive charges may be irritating to both livestock and ranchers. Loss of livestock forage is usually hard to determine; in most cases it is negligible.

Leasing and Development

The PRA has 412 grazing lessees, some of whom would not be affected by oil and gas activities.

Under the proposed action, approximately 4,150 acres of livestock forage would be temporarily eliminated from livestock use by 1990. Approximately 10,650 acres of forage would be lost for the duration of the production in producing fields.

If an average carrying capacity of 7 ½ acres per animal unit month (AUM) is used, it can be projected that 1,973 AUMs forage would be lost each year after 1990. This amount of forage would support 328 head of cattle for six months. If 50 ranchers were affected by oil and gas activity, each rancher would lose the capacity for 6 to 7 head of cattle a year. These losses appear insignificant when compared with the total numbers of livestock found in the resource area (see table 3-15).

Heavy vehicles traveling on access roads increase the hazard of livestock injury or death. Since the rate of occurrence is unpredictable, this impact cannot be quantified.

Dust from frequently used roads can be a nuisance if it is near the ranch house, and it also can affect the palatability of forage as far as ¼ mile from the road; however, rain will periodically wash the dust from the forage. Although dust is recognized as a problem, affecting livestock distribution, the impacts are relatively intangible.

Drilling in or near a lambing or calving pasture during the spring is especially disturbing for the mother animals and newborn. Noise also can become a nuisance to the landowner. Other hazards of the drilling and production phases are that livestock can become mired in mud or can drown in unfenced reserve or production pits, or the animals may drink water contaminated with toxic chemicals.

Losses of livestock forage also can occur from accidental spills of salt water and oil. If such spills follow drainages, they can affect the most productive areas of the range.

Noxious weed invasions on abandoned sites prevent the growth of useful forage. If abandoned sites are not properly rehabilitated, AUMs are lost from production for an additional time. Unseeded sites also can induce erosion and increase silt loads in drainages; this affects forage production and availability.

Abandoned sites that are reseeded with grass mixtures and left unfenced may be heavily grazed by livestock, which prefer the tender new vegetation to surrounding native vegetation. This impairs seedling establishment.

Rights-of-Way

Impacts on ranching from rights-of-way would be similar to those caused by leasing and development.

Impact Summary

An unavoidable adverse impact would be an annual loss of 1,973 AUMs of forage by 1990 and possibly permanent loss of approximately 100 AUMs. This is a significant loss on an individual basis; however, it probably would be insignificant overall. Other unavoidable adverse impacts would be the occasional loss of livestock to vehicle accidents, contaminated water or vegetation, or drowning in reserve pits, as well as disturbance during calving or lambing and straying of animals. The increased level of disturbance of humans by oil and gas activities is an unavoidable nuisance factor.

The occasional loss of livestock and the loss of forage on unreclaimed or reclaimable sites (up to 100 AUMs) would be irreversible commitments of resources.

Oil and gas activity generally has a short-term effect on ranching. Developing fields could significantly affect forage production on individual ranches over the long term; however, the total areawide effects would be insignificant.

Recreation

Information obtained from the *Wyoming Statewide Comprehensive Outdoor Recreation Plan* (SCORP—Wyo. Recreation Commission 1980) says that although the current municipal park acreage is adequate, there are shortages in most other recreation facilities. Large growth in regional population is expected to make these shortages even more severe by 1990. It is projected that coal development will cause a 27% increase in the population of Natrona and Converse counties. Projected oil and gas development are expected to result in another 2% of growth. The projected shortages would be componded by the use of lands for geophysical exploration, leasing and development, and related rights-of-way because such uses would reduce the quality of areas as prime recreation areas.

The ultimate effect of oil and gas activity would be decreased recreation quality and a corresponding unquantifiable decrease in visitation to areas now used for recreation. Surface disturbance is expected on approximately 17,750 acres by 1990; however, an estimated 7,100 acres will be rehabilitated or in the process of rehabilitation by that date. Traffic, noise, and congestion would be expected to increase during the ten-year drilling period.

Geophysical Exploration

Disturbance of wildlife during hunting season would reduce the chance of hunter success. Vehicular travel over undisturbed areas now suitable for primitive types of recreation would reduce the desirability of these areas for hiking, horseback riding, hunting, and other primitive types of recreation. The degree and longevity of the disturbance would depend on the method and location of exploration activities and the success of rehabilitation.

Leasing and Development

Noise, visual intrusions, and odors associated with oil and gas production could diminish an area's aesthetic value, disturb or eliminate normal use patterns, and, depending upon the actual location of the surface disturbance, minimize the importance of an area as a recreation site.

The health and safety aspects of oil and gas development affect individuals engaged in any activity. Risks have been reduced through normal operating procedures, yet they persist through the potential for human error, mechanical failure, or chance. A common precaution for the reduction of the risk of sickness, injury, and death is the physical separation of the individual from the source of the hazard. These harzards, whether real or perceived, keep people from recreation in oil fields. In addition, some operators openly discourage the use of their fields for recreation purposes.

Rights-of-Way

Access roads to drilling operations can cause substantial impacts to recreation. Although many roads are under private control, drilling operations can open previously inaccessible areas to recreationists; on the other hand, increased access and hence increased traffic detracts from the quality of the experience of persons who enjoy the sense of solitude the backcountry can offer. Increased use, especially when not managed, can mean increased environmental damage as the concentration of people increases. Other impacts that can be caused by increased use are visitor conflicts, soil compaction, littering, water pollution, loss of vegetative cover, fire danger, and the removal or disturbance of cultural values.

Current land use planning decisions prevent impacts to recreation resources in some special BLM areas identified in chapter 3. In other cases, site-specific stipulations to protect water resources or wildlife eliminate some secondary adverse impacts to recreation. Impacts that would remain are hard to quantify because the location of future oil and gas development is unpredictable and because some effects may be considered beneficial or adverse, depending on personal preference.

Impact Summary

An unavoidable adverse impact would be the increased demand for and use of existing facilities, which have not increased in supply. As described earlier, the use of public land for oil and gas activity would decrease the amount of land available for recreation or greatly affect its desirability for this use.

The aesthetic recreation experience would be irretrievably lost because of the increased number of users on existing recreation areas.

The short-term effect would be increased use of a resource that is in short supply, which would create an undesirable management situation. The long-term effect would be the reduction of potential recreation opportunities where fields are developed.

SOCIOECONOMIC EFFECTS

Tables 4-5 and 4-6 present the highest incremental employment and population changes that would result from each alternative. Table 4-7 presents the changes in revenue and expenditure levels that could be expected for local governmental entities.

TABLE 4-5
INCREMENTAL EMPLOYMENT EXPECTED TO RESULT FROM THE ALTERNATIVES

Converse County

1990 employment without additional federal oil & gas leasing:	8,480
Additional oil & gas employment due to the continuation of federal policies: [1]	220
Induced secondary employment: [1]	200
Total projected 1990 employment: [2]	8,900

Goshen County

1990 employment without additional federal oil & gas leasing:	3,500
Additional oil & gas employment due to the continuation of federal policies: [1]	-0-
Induced secondary employment: [1]	-0-
Total projected 1990 employment: [3]	3,500

Natrona County

1990 employment without additional federal oil & gas leasing:	43,070
Additional oil & gas employment due to the continuation of federal policies: [1]	120
Induced secondary employment: [1]	110
Total projected 1990 employment: [2]	43,300

Platte County

1990 employment without additional federal oil & gas leasing:	3,000
Additional oil & gas employment due to the continuation of federal policies: [1]	-0-
Induced secondary employment: [1]	-0-
Total projected 1990 employment: [4]	3,000

[1] Derived from the Powder River I-O model.

[2] From the Powder River Regional Coal Environmental Impact Statement (USDI, BLM 1981).

[3] Estimate is slightly over the actual 1979 employment level to include possible additional employment by railroad and ETSI.

[4] This estimate is based on an expected decline in employment as the construction phase of the Laramie River Power Station ends and the operational phase begins (probably in 1982). It also takes into account the transition from construction to operation of the railroad facilities in Guernsey. This does not take into account the possibility that the CF&I iron mine at Sunrise may not reopen.

TABLE 4-6
INCREMENTAL POPULATION EXPECTED TO RESULT FROM ALTERNATIVES

	1990 1/ Baseline	Increment	1990 Population
Converse County	20,400	1,000 2/	21,400 3/
Douglas	8,800	400 4/	9,200 4/
Glenrock	4,000	200 4/	4,200 4/
Goshen County	12,200	-0- 4/	12,200 5/
Torrington	5,500	-0- 4/	5,500 4/
Natrona County	83,600	400 2/	84,000 3/
Casper	59,200	300 4/	59,500 4/
Platte County	10,000	-0- 4/	10,000 5/
Wheatland	4,900	-0- 4/	4,900 4/
Guernsey	1,250	-0- 4/	1,250 4/

1/ 1990 population less the incremental population.
2/ Result of applying the 1980 county population/employment ratio to the additional employment projected in Table 4-5.
3/ From the Powder River Regional Coal Environmental Impact Statement (USDI, BLM 1981).
4/ Based on the 1980 preliminary census ratio of city population to county population.
5/ Result of applying the 1980 county population/employment ratio to the employment projected in Table 4-5.

TABLE 4-7
PROJECTIONS OF INCREMENTAL BUDGET LEVELS FOR 1990 FOR COUNTIES, SCHOOLS, AND COMMUNITIES AS A RESULT OF THE ALTERNATIVES

	1990 Baseline 1/ ($1,000)	Increment ($1,000)	Total ($1,000)
Converse County			
Revenues	12,900	200 2/	13,100 4/
Expenditures	12,900	600 3/	13,500 5/
Balance	-0-	-400	-400
Douglas			
Revenues	10,300	-0- 2/	10,300 4/
Expenditures	10,300	500 3/	10,800 5/
Balance	-0-	-500	-500
School District #1			
Revenues	23,600	300 2/	23,900 4/
Expenditures	23,600	1,200 3/	24,800 5/
Balance	-0-	-900	-900
Glenrock			
Revenues	1,900	-0- 2/	1,900 4/
Expenditures	1,900	100 3/	2,000 6/
Balance	-0-	-100	-100
School District #2			
Revenues	8,900	400 2/	9,300 4/
Expenditures	8,900	400 3/	9,300 6/
Balance	-0-	-0-	-0-
Goshen County			
Revenues	1,900	-0- 2/	1,900 4/
Expenditures	1,900	-0- 3/	1,900 6/
Balance	-0-	-0-	-0-
Torrington			
Revenues	4,200	-0- 2/	4,200 4/
Expenditures	4,200	-0- 3/	4,200 6/
Balance	-0-	-0-	-0-
School District #1			
Revenues	8,000	-0- 2/	8,000 4/
Expenditures	8,000	-0- 3/	8,000 6/
Balance	-0-	-0-	-0-
Natrona County			
Revenues	42,800	200 2/	43,000 4/
Expenditures	42,800	200 3/	43,000 5/
Balance	-0-	-0-	-0-

TABLE 4-7
(continued)

	1990 Baseline [1] ($1,000)	Increment ($1,000)	Total ($1,000)
Casper			
Revenues	50,100	-0- [2]	50,100 [4]
Expenditures	50,100	300 [3]	50,400 [5]
Balance	-0-	-300	-300
School District #1			
Revenues	37,100	400 [2]	37,500 [4]
Expenditures	37,100	200 [3]	37,300 [5]
Balance	-0-	200	200
Platte County			
Revenues	2,400	-0- [2]	2,400 [4]
Expenditures	2,400	-0- [3]	2,400 [6]
Balance	-0-	-0-	-0-
Wheatland			
Revenues	2,800	-0- [2]	2,800 [4]
Expenditures	2,800	-0- [3]	2,800 [6]
Balance	-0-	-0-	-0-
School District #1			
Revenues	5,800	-0- [2]	5,800 [4]
Expenditures	5,800	-0- [3]	5,800 [6]
Balance	-0-	-0-	-0-
Guernsey			
Revenues	500	-0- [2]	500 [4]
Expenditures	500	-0- [3]	500 [6]
Balance	-0-	-0-	-0-
School District #2			
Revenues	1,100	-0- [2]	1,100 [4]
Expenditures	1,100	-0- [3]	1,100 [6]
Balance	-0-	-0-	-0-

[1] Derived from the total expenditures by subtracting the incremental expenditures due to this action. It is assumed that baseline budgets will be balanced; that is, expenditures will equal revenues.

[2] Includes estimates of local share of severance taxes, sales and use taxes, federal royalty refunds, and property taxes, based on 1979 mill levies, oil and gas prices, and county/community population ratios as applied to the projected results of the alternatives.

TABLE 4-7
(continued)

[3] 1979 per capita expenditure levels applied to increase in population expected to result from this action.

[4] 1990 baseline revenues plus estimated incremental revenues due to this action.

[5] Baseline expenditures from the Powder River Regional Coal Environmental Impact Statement (USDI, BLM 1981).

[6] 1979 per capita expenditure applied to total projected 1990 population, including the result of this action.

Potential county expenditures in Converse County due to the alternatives could exceed potential revenues, resulting in a deficit that would require additional tax levies, user fees, grants, or debt at the county level. When the potential deficit resulting from this action in Converse County is added to the deficit potential resulting from Alternative 4 in the *Powder River Regional Coal Environmental Imapct Statement* (USDI, BLM 1981), the cumulative deficit would be about 5% of the budgeted expenditures ($13.8 million) projected under that alternative. Alternative 4 of the DEIS would lease 2.6 billion tons of federal coal reserves in the Powder River region. This represents the "worst-case" situation. For Douglas and School District 1, the potential deficit would be about 6% and 5.5%, respectively, of the possible expenditure levels ($11.0 and $25.9 million) under Alternative 4 in the DEIS.

This action would not change the deficit potential for Natrona County, and it could lower the potential deficit for Natrona's School District 1 from about 2.3% to about 1.89% of possible expenditure levels ($44.1 million) under Alternative 4 in the DEIS. However, the potential deficit for the city of Casper could increase from about 2.3% of possible expenditure ($51.6 million) levels to about 2.9%.

EFFECTS OF THE ALTERNATIVE

This alternative would provide additional protection to the soil, air, and water resources and reduce the noise levels in the vicinity of established recreation areas. Additional acreage would be made available for exploration and development because restrictions on turkey habitat would be relaxed and the "no surface occupancy" restriction would be removed from parcels previously protected for cultural resources. This alternative also would provide year-round protection for critical elk winter habitat and bald eagle roosting and perching areas. The following sections describe the effects of some of the special stipulations described under "Alternative 2" in chapter 2.

AIR QUALITY

Residential area stipulation 1 would improve air quality in the vicinity of sensitive areas by reducing the amount of blowing trash and smoke. Trash would be placed in covered containers and removed from the location or burned on location in incinerators approved by the Wyoming DEQ.

WATER RESOURCES

Soil stipulation 1 would reduce the probability and frequency of water pollution resulting from reserve pit leaks and ruptures.

WILDLIFE

Tree removal might be permitted on nearly 180,000 acres of turkey year round habitat under wildlife stipulation 2; therefore, removal would be restricted on less than 1,000 acres of winter habitat.

Oil and gas development on critical range for elk would be restricted year-round instead of seasonally under wildlife stipulation 1. The proposed action would allow wells to be established in the off-season, and producing wells then would be allowed to continue maintenance and operation during the winter under the proposed action.

Wildlife stipulation 1 also would restrict oil and gas development from bald eagle roosting and perching habitat year-round rather than seasonally. As in critical range for elk, this differs from the proposed action because it would mean that producing wells would not be established in bald eagle habitat; therefore, no continuance of maintenance and operation would occur.

A long-term effect of this alternative is that it would prevent destruction of critical winter habitat for elk and of roosting and perching habitat for bald eagles. The easing of restrictions on 180,000 acres of turkey habitat also would be a long-term effect.

NOISE

Wildlife stipulation 1 and recreation stipulation 1 would help mitigate adverse impacts caused by excessive noise conditions.

RESIDENTIAL AREAS

The special stipulations described in chapter 2 would be applied for residential areas when it is determined that they are necessary. These special stipulations would effectively mitigate impacts described for the proposed action.

RECREATION

Wildlife stipulation 1 would help mitigate impacts to areas of recreational importance. The effectiveness of stipulations cannot be quantified, as some impacts could be considered beneficial or adverse, depending upon personal preference.

CHAPTER 5: CONSULTATION AND COORDINATION

PREPARERS

Jim Melton, Project Manager	Platte River Resource Area Manager
Leo Coleman, Team Leader	Writer-editor, Air Quality, Topography, Lands, Required Elements
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CONSULTATION DURING PREPARATION OF THE ANALYSIS

In addition to the workshop participants, individuals from the following agencies and groups provided information during the preparation of this environmental assessment.

Wyoming Oil and Gas Conservation Commission, Casper

National Park Service, Denver

Wyoming Game and Fish Department—Wheatland, Casper, Cheyenne, and Rawlins

BLM, Wyoming State Office, Cheyenne

Bureau of Reclamation, Casper

Petroleum Association of Wyoming, Casper

U.S. Fish and Wildlife Service, Fort Collins, CO

Wyoming Department of Economic Planning and Development, Cheyenne

Wyoming State Highway Commission, Casper

Natrona County Road and Bridge Department, Casper, WY

Converse County Clerk, Douglas, WY

Platte County Clerk, Wheatland, WY

Goshen County Clerk, Torrington, WY

Wyoming Department of Environmental Quality

PUBLIC PARTICIPATION

BLM Workshop

The BLM held a workshop at the Natrona County Library April 15, 1981, to help determine the major issues that should be discussed in the oil and gas environmental assessment. The list of potential participants was compiled from suggestions made by the Casper District manager and by resource specialists from the PRA. In addition to BLM Staff, 27 persons were invited to attend, many in a dual capacity. Those invited represented ranching (4); state, county, and federal agencies (8); environmental protection groups (1); the District Advisory Board (7); public utilities (2); and the oil and gas industry (8). The 23 persons who attended are named in the work group listings.

The purpose of the workshop was twofold: to solicit public participation in the EA and to determine impacts, issues, and mitigating measures that should be discussed. Both objectives are mandated by the regulations of the Council on Environmental Quality, which were published in 1978.

A BLM press release of April 15, 1981, described the workshop and the purpose and scope of the EA. The release was sent to all district news media. Media representatives were invited to the meeting; none attended.

Problems and issues brought out at the workshop, as well as those of concern to BLM managers, are incorporated in this document.

Workshop Attendance

The following persons took part in the April 15 workshop:

Bob Wilber, BLM, Casper District Manager

Work Group 1: Leasing and Resource Protection

Jim Melton, BLM, PRA Manager
Leo Coleman, BLM, Natural Resource Specialist
Willie Fitzgerald, BLM, Wildlife Biologist
Larry Patte, Wyoming Game and Fish, Biologist
Fred Eiserman, ETSI, Advisory Board
Art Anderson, U.S. Fish and Wildlife Service
LeRoy Fuesner, Wyoming Department of Environmental Quality
Lee Coffman, Landowner, Advisory Board
Steve Lathrop, Landowner
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Work Group 2: On-the-ground Action

Don Rhea, BLM, Chief, Division of Operations
Richard Hopkins, BLM, Wyoming State Office
Jack Chidley, Marathon Oil Company
Sue Cole, Legislative Assistant, Advisory Board
Reg Rothwell, Wyoming Game and Fish, Biologist
Don Basko, Wyoming Oil and Gas Commission

Jerry Lock, Amoco Production Company
Ed Coster, Amoco Production Company
Doug Richardson, Marathon Oil Company
Bob Anderson, Consultant, Heitzman Drill Site Services
Richard Robitaille, Petroleum Association of Wyoming
E.L. Spieles, Marathon Oil Company
Harold A. Schmitz, Amoco Pipeline Company

Work Group 3: Rights-of-Way

Mike Ford, BLM, Chief, Branch of Surface Protection
Sam Hakes, Jr., Marathon Pipeline Company (Platte Pipeline Co.)
Dick Braun, Chinook Pipeline Company
Gene Hardy, Landowner, Advisory Board
Geoff Hulse, Forest Service (Thunder Basin National Grasslands)
Evertt C. McVay, Hot Springs County R.E.A.

APPENDIXES / REFERENCES

APPENDIX 1: LAWS AND ENFORCING AGENCIES

Numerous laws and regulations directly or indirectly affect the oil and gas industry and associated governmental agencies. Some of these laws and regulations are listed below. They are supplemented by the booklet Oil and Gas: Surface Operating Standards for Oil and Gas Exploration and Development, which was written by the Bureau of Land Management, the Geological Survey, and the Forest Service.

AIR QUALITY

Clean Air Act of 1970.

EPA Primary and Secondary National Ambient Air Quality Standards (NAAQS), Federal Register, April 30, 1979.

Wyoming Environmental Quality Act, January 22, 1972, Article 2.

Mineral Leasing Act of 1920, 30CFR221. (GS controls H_2S emissions.)

Wyoming Oil and Gas Commission regulates flaring or venting of natural gas.

MINERALS MANAGEMENT

Mineral Leasing Act of 1920, Title 30 CFR, parts 211, 221. Title 43 CFR, parts 3045, 3100.

WSO Supplement to Bureau Manual 3045, 1977.

WSO Supplement to Bureau Manual 3109, 1976.
Wyoming Oil and Gas Commission issues and administers oil and gas leases on state lands.

WATER QUALITY

Federal Water Pollution Control Act (FWPCA) as amended in 1971 (Public Law 92-500).

Clean Water Act of 1977 (Public Law 95-190).
Section 404, 33 USC, 125 Det Seg., 40 CFR, Parts 110, 112; 33 CFR, parts 322, 323

National Environmental Policy Act of 1969 (Public Law 91-190)

Wyoming Environmental Quality Act of 1973 (WS 35-11-301, WS 35-11-302).

Chapter IV, Section 5 of the DEQ Water Quality regulations

Abandoned Drill Hole Act (35-502.22:1)

WATER RIGHTS

Wyoming Water Law

SOLID WASTE DISPOSAL

Wyoming Solid Waste Management Rules and Regulations of 1975.

VEGETATION AND WILDLIFE

Endangered Species Act of 1973
50 CFR 402 (January 4, 1978)

Bald Eagle Protection Act of 1940. USFWS enforces.

Migratory Bird Treaty Act of 1918.

Weed and Pest Act of 1973.

North Platte River Area Designated (Noxious) Weed Treatment Program. Environmental assessment record by BLM, December 1978.

Mineral Leasing Act of 1920
Taylor Grazing Act of 1934

FLOODPLAIN MANAGEMENT

Executive Order 11988, May 24, 1977.

PROTECTION OF WETLANDS

Executive Order 11990, May 24, 1977.

CULTURAL RESOURCES

Antiquities Act of 1906
Archeological Resources Protection Act of 1979
National Historic Preservation Act of 1966
Historic Site Act of 1935
Executive Order 11593, 1971
Federal Land Policy and Management Act of 1976, Sec. 102 (a)(8), Sec. 302 (b).

WILDERNESS

Federal Land Policy and Management Act of 1976, Sec 603
Wilderness Act of 1964

LANDS

Rights-of-way: Federal Land Policy and Management Act of 1976
Title 43CFR2800
Mineral Leasing Act of 1920

Pipeline Transmission: Department of Transportation and ICC, Title 49 CFR, parts 191, 192.

Highways: State statutes.

LAND USE PLANS

Federal

The following federal land use plans address mineral development in the PRA:

Medicine Bow National Forest and Grassland Management Plan, Forest Service.

Management Framework Plans developed by the Casper District, BLM: Converse MFP, Natrona MFP, and the Lower Platte MFP, which addresses public land in Platte and Goshen counties.

BLM plans can be reviewed at the Casper District office. The Forest Service plan can be reviewed at the office in Douglas or at forest headquarters in Laramie.

State

A land use plan prepared by the state of Wyoming does not contain specific recommendations relative to oil and gas development. The plan, a general overview of resources within the state, identifies land uses and other factors that should be addressed in county land use plans.

County

Natrona, Converse, Platte, and Goshen counties have each prepared land use plans. Each plan views development according to the county's dependence on property tax revenues generated from resource production. The Platte and Goshen land use plans lean heavily toward protection of agricultural interests; the Converse plan recognizes the importance of mineral development.

Areas of concern to the counties include development near historic landmarks, county-city recreation areas, and oil and gas development in or near urban areas. Each county plan lists a number of significant historic sites.

APPENDIX 2: SLOPE CONVERSION CHART

Percentage of Slope	Slope in Degrees	Slope Ratio
100%	45°	1:1
90%	42°	1.11:1
80%	38°40'	1.25:1
70%	35°	1.43:1
60%	31°	1.66:1
50%	26°30'	2:1
40%	21°50'	2.5:1
33.3%	18°30'	3:1
30%	16°50'	3.3:1
25%	14°9'	4:1
20%	11°20'	5:1
16.6%	9°25'	6:1
14.4%	8°5'	7:1
12.5%	7°10'	8:1
11.1%	6°20'	9:1
10%	5°40'	10:1

APPENDIX 3: EFFLUENT LIMITATIONS FOR PRODUCED WATER IN WYOMING

Produced water is defined as underground water which surfaces through oil and/or gas wells and which is usually disposed of by reinjection, discharged to complete containment ponds, or after treatment for removal of oil, discharged to surface waters of the state.

Chlorides: The chloride content of any produced water discharge shall not exceed 2,000 mg/l in any single properly preserved grab sample except in those cases where a modification is granted for beneficial use or in extenuating circumstances.

Sulfates: The sulfate content of any produced water discharge shall not exceed 3,000 mg/l in any single properly preserved grab sample except in those cases where a modification is granted for beneficial use or in extenuating circumstances.

Total Dissolved Solids: The total dissolved solids content of any produced water discharge shall not exceed 5,000 mg/l in any single properly preserved grab sample except in those cases where a modification is granted for beneficial use or in extenuating circumstances.

pH: In no case shall the pH of any produced water discharge be less than 6.5 or greater than 8.5 as measured by a single grab sample.

Oil and Grease: In no case shall the oil and grease content of any produced water discharge exceed 10 mg/l in any single properly preserved grab sample.

Toxic Substances: In no case shall any produced water discharge contain toxic substances in concentrations or combinations which are toxic to human, animal or aquatic life.

Additional Limitations: The state reserves the right to impose limitations on additional parameters or to impose limitations more stringent than those given above to protect water quality.

Source: Wyoming Water Quality Rules and Regulations, Chapter VII.

APPENDIX 4: VEGETATION

This appendix describes the vegetation of the various range sites and the seeding recommendations for the PRA. Material is from range seeding guides and range site technical guides prepared by the Soil Conservation Service, U.S. Department of Agriculture.

RANGE SEEDING

Definition

Establishing adapted plants by seeding on native grazing land (does not include pasture and hayland planting).

Purpose

To: (1) Prevent excessive soil and water loss and improve water quality; (2) produce more forage for grazing or browsing animals on rangeland or land converted to range from other uses; and (3) improve the visual quality of grazing land.

Conditions Where Practice Applies

On all rangeland, native pasture, grazable woodland, and grazed wildlife land.

Planning Considerations

(1) Land to be seeded must have soil and climate that can support a satisfactory cover of adapted range forage plants; (2) grazing management alone cannot restore a satisfactory cover of desirable species within a reasonable period of time; (3) species or cultivars selected for seeding must be compatible with the planned management of the entire operation unit; (4) management must be able to maintain the stand after seeding is completed.

Specifications

A. Seedbed Preparation: A suitable seedbed will be prepared using one of the following methods:

1. Conventional method:

   A firm weed free seedbed will be prepared.

2. Prepared cover:

   a. Prepare a seedbed suitable to the preparatory crop to be grown.

   b. An adapted crop will be selected and seeded at the rate, depth, date, and method indicated below:

Crop	Seeding Rate Dryland Lbs/Ac	Seeding Rate Dryland Kg/Ha	Depth of Planting	Seeding Method	Seeding Dates
Spring grains	40-60	(45-67)	2" (5cm)	Drill	Apr 1 - Jul 1
Sorghums	10-15	(11-17)	2" (5cm)	Drill	May 15 - Jul 15
Sudangrass	10-15	(11-17)	1½" (3.8cm)	Drill	May 15 - Jul 15
Foxtail millet	12-18	(13-20)	1" (2.5cm)	Drill	May 15 - Jul 15

c. Small grains are limited to areas with more than 10 inches (25cm) annual precipitation.

d. Crops will be mowed or harvested as needed to prevent them from producing seed.

e. If cover is needed to provide erosion control and a preparatory crop cannot be established, refer to the standard and specification for "Mulching," Section IV, Technical Guide.

3. Stubble mulch fallow.

4. Existing stubble:

If free from weeds and volunteer grain the seeding can be made directly into stubble.

B. Methods of planting: All seedings will be made with a drill or grass seeder.

1. Drill method: The best type of seeding equipment is a grass drill equipped with double disc furrow openers with depth bands and packer wheels.

2. Range interseeding method

a. Where applicable

(1) When normal seedbed preparation methods are very hazardous because of soils or topography. Generally, this will be the loamy fine sand to fine sand textured soils.

(2) Where desirable established grasses are found in a very thin stand or in patches, not uniformly throughout, but too abundant to destroy.

b. Equipment

(1) The interseeder shall make a furrow at least 12 inches (30cm) wide, 2 to 3 inches (6-8cm) deep, and shall be spaced not more than 42 inches (106cm) apart. The interseeder shall be equipped to plant fluffy and free-flowing grass seeds. The interseeder will be equipped with double disc furrow openers, depth bands, and packer wheels or drag chains.

(2) The operation shall be on the contour, where practical.

C. Fertilizer:

1. Fertilizer is normally not recommended for range seeding.
2. Where fertilizer is applied, the amounts will be determined by soil test results.

D. Adapted species:

1. Refer to technical range site descriptions for species adapted to individual range sites.
2. Species most commonly used for range seeding are given in Attachment #1.
3. Refer to "Partial List of Sources of Grass and Legume Seed" in the front of the National Plant Materials Handbook for availability of seed by species.

E. Seeding rates and mixtures:

1. Minimum seeding rates are given on Attachment #1, "Seeding Rates for Range Seeding."
2. Mixtures are to be determined from technical range site descriptions, Section II-E of Technical Guide. Percentages of species normally found in the potential native plant community are listed by range sites in the descriptions. If excellent range condition is not the goal, seeding rates of individual species can be adjusted to meet special purposes consistent with the conservation objectives for the given range site.

3. All seeding rates are for pure plantings of the individual species. When seeding mixtures, use a percentage of the seeding rate of each species equal to the percentage of the species in the mixture.

4. For row spacings wider than 24 inches (61cm), interseeding, and other renovated rangeland, use one-half of minimum PLS seeding rate.

5. Seeding depth should be ¼ to ½ inch (6-12mm) in loam or heavier textured soils, and ½ to ¾ inch (12-18mm) in light textured soils but will not be less than ¼ nor more than 1 inch (6-25mm).

F. Time of seeding:

1. Predominantly Cool Season Species:

   Seeding will be made after soil temperature is low enough to prevent germination in the Fall up to but no later than April 15 as long as soil conditions allow the preparation of a suitable seedbed.

2. Predominantly Warm Season Species:

   Seedings will be made in early Spring up to but no later than May 15.

G. See treatment:

1. Treat seed with fungicide* if past history of field indicates disease to be a problem.

2. Some fungicides* are toxic - READ THE LABEL.

H. Management of new seeding:

1. Do not graze until seeding becomes established. Minimum protection from grazing will be from the time of seeding for one full year and one growing season.

2. Clip, shred, or apply herbicides* to weeds, if necessary, to control competing or undesirable vegetation. Refer to "Wyoming Weed Control Guide," published by the Agriculture Extension Service, University of Wyoming, for application rates of herbicide. Minimum clipping height will be 4 inches (10cm).

When forbs and/or shrubs are used to supplement the grass seed mixture the broadleaf and grassy weeds will be controlled only by mowing or shredding.

3. Infestation of grasshoppers will be sprayed for control when necessary during the establishment of plants.

4. When possible, fires will be prevented.

5. When feasible, seeded areas will be grazed separately from adjacent native range.

6. The degree to which the key forage species will be grazed following protection will be in accordance with specifications for "Proper Grazing Use," Section IV, Technical Guide.

*CAUTION: If pesticides are handled or applied improperly, or if unused portions are not disposed of safely, they may be injurious to humans, domestic animals, desirable plants, and fish or other wildlife; and they may contaminate water supplies. Drift from aerial spraying can contaminate nearby crops and other vegetation. Follow the directions and heed all precautions on the container label.

Attachment 1

SEEDING RATES FOR RANGE SEEDING

Species 1/	Approximate Seeds Per Pound (.45 Kg)	Seeding Rate Lbs PLS/Acre (Minimum) (Kg PLS/Ha)	No. Seeds Per Running Foot At Various Row Spacings				
			6" (15cm)	7" (18cm)	8" (20cm)	10" (25cm)	12" (30cm)
Alkali cordgrass 4/							
Alkali sacaton	1,758,000	0.5 (0.6)	10	12	13	17	20
Basin wildrye	140,000	5.0 (5.6)	9	10	12	15	18
Beardless wildrye		6.0 (6.7)	10	12	13	17	20
Big bluegrass	917,000	1.0 (1.1)	10	12	14	17	20
Big bluestem 4/	165,000	4.0 (4.5)	7	9	10	12	14
Blue grama 4/	825,000	1.0 (1.1)	9	11	13	16	18
Bluebunch wheatgrass 5/	140,000	7.0 (7.8)	9	11	13	15	17
Bluejoint reedgrass							
Bottlebrush squirreltail							
Canada wildrye	115,000	6.0 (6.7)	8	9	10	13	16
Columbia needlegrass							
Galleta	159,000						
Green needlegrass* 5/	140,000	5.0 (5.6)	9	11	13	16	18
Idaho fescue 2/	500,000	2.0 (2.2)	10	12	14	17	20
Indian ricegrass* 5/	141,000	6.0 (6.7)	10	12	13	17	20
Little bluestem 4/	260,000	2.5 (2.8)	8	9	10	13	16
Mountain brome	90,000	10.0 (11.2)	10	11	13	16	20
Mutton bluegrass							
Nebraska sedge							
Needleandthread*	115,000	6.0 (6.7)	8	9	10	13	16
Nodding bromegrass							
Northern reedgrass							
Nuttalls alkaligrass	2,108,000	.5 (0.6)	10	11	13	16	20
Prairie cordgrass							
Prairie sandreed 4/	273,700	2.5 (2.8)	8	9	10	13	16
Pumpelly brome							
Reed canarygrass	533,000	3.5 (3.9)	20	22	26	32	40
Sand bluestem 4/	113,000	6.0 (6.7)	7	9	10	12	14
Sheep fescue (Covar) 2/	680,000						
Sideoats grama	191,000	4.5 (5.0)	10	12	13	17	20
Slender wheatgrass	159,000	4.0 (4.5)	8	9	10	13	16
Spike fescue	200,000	4.0 (4.5)	10	12	14	17	20
Streambank wheatgrass	170,000	5.0 (5.6)	10	12	14	17	20
Switchgrass 4/	389,000	2.5 (2.8)	11	12	14	18	22
Thickspike wheatgrass	156,000	6.0 (6.7)	10	12	14	17	20
Tufted hairgrass							
Western wheatgrass	110,000	6.0 (6.7)	10	12	14	17	20
Shrubs 1/ 6/							
American plum	840						
Antelope bitterbrush	20,000						
Big sagebrush	2,500,000						
Black sagebrush							
Bud sagebrush							
Chokecherry							
Cottonwood (Sargent's)							
Curlleaf mountainmahogany	44,000						
Fourwing saltbush 3/ 5/	22,500						
Gardners saltbush							
Greasewood							
Juniper	28,600						
Low sagebrush							
True mountainmahogany							
Serviceberry	2,000						
Silver sagebrush							
Winterfat	90,000						
Forbs 6/							

1/ Approved varieties developed from native species are recommended when available.
2/ Sheep fescue may be substituted for Idaho fescue.
3/ Recommended seeding rate for Wytana fourwing saltbush in seeding mixtures is between 1/2 and 1 pound PLS per acre (.6-1.1).

4/ Spring seeding preferred.
5/ Fall seeding preferred.

6/ "More data is needed on seeding rates for forbs and shrubs. Generally, 1/10 pound PLS/Acre (.1 Kg/Ha) of Small seeded to 1/2 pound PLS/Acre (.6 Kg/Ha) of Large seeded forbs and shrubs may be added to seeding mixtures without reducing the full grass seeding rates."

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
10"-14" NORTHERN PLAINS PRECIPITATION ZONE
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

Maximum percentage in climax by range site

Key Climax Plants	WL	Sb	SS	LL	OV	CyO	SL	Sa	Sy	Ly	Cy	DC	SwSy	SwLy	SwCy	SU	VS	Sh
Alkali cordgrass			5*															
Alkali bluegrass			5*				15											
Alkali sacaton			50				25									10		5*
Basin Wildrye		10		5*	50	50												
Big bluestem																	5*	
Bluebunch wheatgrass										5*			10	50	15		50	10
Bearded wheatgrass		5*		5*														
Bluejoint wheatgrass	25																	
Blue and Hairy grama					5*			5*	10	15	10		10	10	5*		5*	
Buffalo grass						5*						5*			5*			
Baltic rush		5*																
Canada wildrye		5*		5*	5*	10												
Canby bluegrass					10	10						5*			5*		5*	5*
Cusicki bluegrass					10	10				10	10			5*	5*		10	
Green needlegrass				25	25	20				15	40	30	10	5*	40			
Indian ricegrass								10	15	5*				5*		10	5*	10
Inland saltgrass		5*	10				15									15		10
Inland sedge		5*																
Little bluestem									10	5*			10	10			10	15
Mat muhly		5*	5*	5*	5*	5*												
Nebraska sedge	25	15																
Northern reedgrass	25																	
Nuttalls alkaligrass			10				10											
Needleandthread grass				10	5*			15	25	25			25	10			10	
Needleleaf sedge						5*			5*	5*	5*	5*		5*	5*			
Plains reedgrass										5*	5*	5*		5*	5*			5*
Prairie cordgrass		5*																
Prairie sandreed grass								50	20		5*		25				5*	
Prairie junegrass				5*	5*	5*			5*	5*			5*	5*	5*		5*	
Rhizomatous wheatgrass		15	5*	10	25	15	15	10	10	25	40	50		15	40	10	10	25
Red threeawn														5*			5*	
Sand bluestem								25										
Slender wheatgrass		10		10														
Switch grass		5*																
Sandberg bluegrass				5*	5*	5*		5*	5*	5*	5*	5*	5*	5*	5*	10	5*	5*
Sand dropseed								5*	5*				5*				5*	
Stonyhills muhly													5*	5*	5*		5*	
Squirreltail			5*				10					5*			5*	10	5*	
Spike sedge		5*																
Sideoats grama													10	5*				
Threadleaf sedge					5*			5*	10	5*			5*	10	5*		5*	5*
Tufted hairgrass	25	5																
1/ Perennial forbs	10	10	5	10	15	15	10	10	15	15	15	10	15	10	10	5	10	5
Big sagebrush									5a	10	10		5a	5a	5a		5	5
Birdsfoot sagebrush												5a			5a			5
Gardners saltbrush							5a									50		
Greasewood			5				20					5a				10		
Fourwing saltbush							5a						10					
Low rabbitbrush									5a				5a					
Rubber rabbitbrush			10	5a			5a				5			5a				
Silver sagebrush				5a	5			5	5a				5a	5a				
Silverberry				5a														
Skunkbush sumac													5a	5a			5	
Snowberry				5a	5	5			5a									
Winterfat					10	5	10		5a	5	5	5a	5a	5a	5a	10		
Yucca												5a						
Wildrose				5a														
Cottonwoods			5	10			5a											
Conifers and Junipers																	10	10
Willows		10																
* Total % of these species allowed		25	25	25	10	10	-	10	10	25	20	25	10	15	25	-	15	15
a Total % of these species allowed				15			10		15				15	10	10			
Range Condition % Original Vegetation					Initial suggested stocking rates by site (AUM's Acre)													
Excellent 76 - 100	3.0	2.0	1.5	.6	.6	.6	.5	.4	.4	.4	.4	.3	.2	.2	.2	.15	.15	.15
Good 51 - 75	2.5	1.5	1.2	.5	.5	.5	.4	.3	.33	.33	.33	.25	.17	.17	.17	.12	.12	.12
Fair 26 - 50	1.5	1.0	.8	.25	.25	.25	.15	.2	.2	.2	.2	.15	.1	.1	.1	.05	.05	.05
Poor 0 - 25	1.0	.6	.4	.15	.15	.15	.1	.1	.1	.1	.1	.07	.05	.05	.05	.03	.03	.03

Legend 1/ Count no more than 5% of any one species
Blanks - not important

Invaders: All annuals
All exotics
Broom snakeweed
Curly cup gumweed
Foxtail barley
Thistles
Tumblegrass
Cactus

WL - Wetland
Sb - Subirrigated
SS - Saline Subirrigated
LL - Lowland
SL - Saline Lowland
OV - Overflow
CyO - Clayey Overflow
Sa - Sands
Sy - Sandy
Ly - Loamy
Cy - Clayey
DC - Dense Clay
SwSy - Shallow sandy
SwLy - Shallow loamy
SwCy - Shallow Clayey
VS - Very Shallow
Sh - Shale
SU - Saline Upland

USDA-SCS-WY
Field Offices (See Item 9)

Rev. Feb. 1978

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
15"-17" PRECIPITATION ZONE NORTHERN PLAINS
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

Maximum percentage in climax by range site

Key Climax Plants	WL	Sb	SS	LL	OV	CyO	SL	Sa	Sy	Ly	Cy	DC	SwSy	SwLy	SwCy	SU	VS	Sh
Alkali bluegrass			5*				10											
Alkali cordgrass			25															
Alkali sacaton grass			50				25									10		
Baltic rush	10																	
Bearded wheatgrass		10		10														
Big bluestem grass				5*	25					10	10				10			
Blue and hairy grama grass				5*				5*	5*	10	5*		5*	10	10		10	
Bluebunch wheatgrass						5*				5*			10	25	10		25	10
Bottlebrush squirreltail grass			5*	5*	5*	5*	10					5*			5*	5		
Buffalo grass											5*	5*			5*			
Canada wildrye grass		5*		5*	5*										5*			
Canby bluegrass												5*		5*			5*	5*
Green needlegrass				15	25	50			5*	15	50	50		10	25		10	10
Indian ricegrass								10	10				5*			10	5*	
Inland saltgrass			10				10									15		5*
Inland sedge	10	5*																
Little bluestem grass									10	5*			10	10			10	10
Mat muhly grass		5*	5*	5*	5*	5*												
Nebraska sedge	25	10																
Needleandthread grass				5*	5*			15	25	20	5*		25	10			10	
Needleleaf sedge						5*		5*	5*	5*		5*	5*	5*	5*			
Nuttalls alkali grass			10				15											
Plains reedgrass										5*	5*			5*	5*			10
Prairie cordgrass		25																
Prairie junegrass				5*	5*	5*			5*	5*	5*		5*	5*	5*		5*	
Prairie sandreed grass								25	25				25				5*	
Red threeawn grass																	5*	
Reedgrasses	25	5*																
Rhizomatous wheatgrass		5*	25	10	30	40	25	5*		25		25	10	25	25	15	10	25
Sandberg bluegrass				5*		5*		5*	5*	5*	5*	5*	5*	5*	5*	5	5*	5*
Sand bluestem grass								25					5*					
Sand dropseed grass								5*	5*				5*				5*	
Sideoats grama grass										5*	10			10	10		10	5*
Slender wheatgrass		10		10	10	10												
Spike sedge	10	5*																
Stoneyhills muhly grass													5*	5*	5*		5*	
Switchgrass		5*																
Threadleaf sedge					5*			5*	5*	5*			5*	10			10	10
Tufted hairgrass	25																	
1/ Perennial forbs	10	10	5	15	15	15	10	15	10	15	10	5	15	10	15	5	10	10
Big sagebrush										5	5a	10	5a	5a	10		5	
Conifers & Junipers						5a											10	10
Cottonwoods			5	10			5a											
Fourwing saltbrush						5a	5a				5a	5						
Gardners saltbrush							5a									40		10
Greasewood			5				25									10		
Low rabbitbrush									5a				5a					
Rubber rabbitbrush			10	5			5a	5	5a									
Roses				5														
Silver sagebrush				5	5a	5a		5	5a									
Skunkbush sumac													5a	5a			5	
Snowberry				5	5a	5a		5	5a									
Willows	10	10																
Winterfat					5a	5a	5a			5	5a	5	5a	5a	5	5		5
* Total % of these species allowed		10		25	15	10		10	10	15	10	15	15	15	15		10	10
a Total % of these species allowed					10	15	10		10		10		15					

Range Condition % Original Vegetation — Suggested Initial Stocking Rates by Site (AUM'S/Acre)

Range Condition	% Original Vegetation	WL	Sb	SS	LL	OV	CyO	SL	Sa	Sy	Ly	Cy	DC	SwSy	SwLy	SwCy	SU	VS	Sh
Excellent	76 - 100	3.0	2.0	1.5	.7	.7	.7	.6	.5	.5	.5	.5	.4	.35	.35	.35	.35	.2	.2
Good	51 - 75	2.5	1.5	1.2	.6	.6	.6	.5	.4	.4	.4	.4	.33	.3	.3	.3	.15	.15	.15
Fair	26 - 50	1.5	1.0	.8	.3	.3	.3	.25	.25	.25	.25	.25	.2	.15	.15	.15	.05	.05	.05
Poor	0 - 25	1.0	0.6	.4	.2	.2	.2	.15	.1	.1	.1	.1	.1	.1	.1	.1	.03	.03	.03

Legend 1/ Count no more than 5% of any one species
Blanks - not important

Invaders:	All annuals	Curlycup gumweed
	All exotics	Foxtail barley
	Broom snakeweed	

WL - Wetland	CyO - Clayey Overflow	SwSy - Shallow sandy
Sb - Subirrigated	Sa - Sands	SwLy - Shallow Loamy
SS - Saline Subirrigated	Sy - Sandy	SwCy - Shallow Clayey
LL - Lowland	Ly - Loamy	VS - Very Shallow
SL - Saline Lowland	Cy - Clayey	SU - Saline Upland
OV - Overflow	OC - Dense Clay	Sh - Shale

USDA-SCS-WY
Field Offices (See Item 9)

Rev. Feb 1978

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
12"-14" PRECIPITATION ZONE SOUTHERN PLAINS
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

Maximum percentage in climax by range site

Key Climax Plants	WL	Sb	SS	LyL	SyL	SL	LyO	CyO	Sa	Sy	Ly	Cy	CS	CU	GrLy	LU	SwSy	SwLy	SU	Gr	VS
Alkali bluegrass			5*			5*															
Alkali cordgrass			10																		
Alkali sacaton		5*	55			20													5*		
Baltic rush	5																				
Basin wildrye		35					5*														
Big bluestem		15		5*			20							10							
Blowout grass									5*				5*								
Blue grama				15	10				15	20	15	10	5*	5*	10	20	10	20	5*	15	10
Bluebunch wheatgrass														5*	5*		5*	5*		5*	25
Bluejoint reedgrass	25																				
Buffalo grass				5*				5*			5*	5*				5*			5*		
Canada wildrye		5*	5*	5*			5*		5*		5*										
Green needlegrass				5*			10	25			5*	10		5*	5*						
Hairy grama									5*				5*								
Indian grass							5*		5*												
Indian ricegrass		5*		5*	5*	5*				5*	5*		5*	5*	5*		5*	5*	5*		
Inland saltgrass			5*			15															
Little bluestem		10		5*	5*		10		25	5*	5*	5*	15	20	15	5*	5*	5*		45	15
Mat muhly		5*																			
Nebraska sedge	25																				
Needleandthread				25	40		10	5*	10	40	25		15	15	35	25	25	25	5*	20	15
Needleleaf sedge					5*								5*								
Northern reedgrass	15																				
Panic grass													5*								
Plains muhly				5*							5*	5*			5*	5*				5*	5*
Plains reedgrass										5*	5*	5*					5*			5*	5*
Prairie cordgrass	45	10																			
Prairie junegrass				5*	5*		5*		5*	5*	5*	10	5*	5*	5*	5*		5*			5*
Prairie sandreed					5*				5*	5*			50		5*		15				
Red threeawn										5*	5*				5*	5*	5*	5*		5*	5*
Sandberg bluegrass				5*																	
Sand bluestem					5*				40	5*			5*				10				
Sand dropseed				5*	5*				5*	5*	5*		5*	5*	5*	5*	5*	5*		5*	
Sand muhly									5*				5*								
Sand paspalum													5*								
Scribners panicgrass					5*																
Sideoats grama							5*	5*						10	5*	5*	5*	5*			5*
Slender wheatgrass		10		5*			5*	5*													
Slim sedge	5*	5*	5*																		
Switchgrass		10	5*		5*	5*	5*														
Threadleaf sedge				10			5*	5*		5*	5*	5*		5*	5*	15	10	15			5*
Western wheatgrass			15	25	15	50	40	50	5*	10	25	50		20	15	5*	5*	25	50	5*	5*
1/ Perennial forbs	5	10	10	10	10	5	10		10	20	10	10	10	15	20	15	15	10	5	15	10
Big sagebrush				5a				5			5	5									
Bitterbrush																					5a
Cottonwood				15	15																
Fringed sagewort																					
Gardners saltbush																			10		
Greasewood			5			20													10		
Juniper																					5a
Mountain mahogany																		10			35
Ponderosa pine																					5a
Roses				5a	5																
Sand sagebrush							10		5	5			10	5a							
Silver buffaloberry			5			10															
Willows	10	10																			
Yucca									5				5	5a	5	5	5				
* Total % of these species allowed		15	15	20	25	10	30	25	20	30	20	15	25	20	25	30	25	15	25	30	15
a Total % of these species allowed				10										5							10
Range Condition % Original Vegetation	Suggested Initial Stocking Rates by Site (AUM'S/Acre)																				
Excellent 76 - 100	3.0	2.0	1.5	.6	.6	.5	.6	.6	.4	.4	.4	.4	.33	.3	.3	.25	.2	.2	.2	.15	.15
Good 51 - 75	2.5	1.5	1.2	.5	.5	.4	.5	.5	.3	.33	.33	.33	.3	.25	.25	.2	.17	.17	.17	.12	.12
Fair 26 - 50	1.5	1.0	.8	.25	.25	.15	.25	.25	.2	.20	.2	.2	.2	.15	.15	.15	.10	.10	.10	.05	.05
Poor 0 - 25	1.0	.6	.4	.15	.15	.10	.15	.15	.1	.10	.1	.1	.1	.07	.07	.1	.05	.05	.05	.03	.03

1/ Legend - Count no more than 5% of any one species
Blanks - not important

Invaders - All annuals
All exotics
Cactus
Curly cup gumweed
Foxtail barley
Kentucky bluegrass
Broom snakeweed
Thistles
Tumblegrass

WL - Wetland
Sb - Subirrigated
SS - Saline subirrigated
LyL - Loamy Lowland
SyL - Sandy Lowland
SL - Saline Lowland
LyO - Loamy Overflow
CyO - Clayey Overflow
Sa - Sands
Sy - Sandy
Ly - Loamy
Cy - Clayey
CS - Choppy sands
CU - Coarse Upland
GrLy - Gravelly Loamy
LU - Limy Upland
SwSy - Sahllow Sandy
SwLy - Shallow Loamy
SU - Saline Upland
Gr - Gravelly
VS - Very Shallow

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
15"-17" PRECIPITATION ZONE SOUTHERN PLAINS
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

	Maximum percentage in climax by range site															
Key Climax Plants	WL	Sb	SS	LL	LyO	CyO	Sa	Sy	Ly	Cy	Gr Ly	CU	Sw Sy	Sw Ly	Gr	VS
Alkali bluegrass			5*													
Alkali cordgrass			5*													
Alkali sacaton			55													
Baltic rush	10															
Basin wildrye																
Big bluestem		45			25											
Blue grama				10			5*	5*	15	5*	5*	5*	5*	10	10	5*
Bluejoint reedgrass	25															
Blowout grass							10									
Bluebunch wheatgrass											10	20	5*	25	25	40
Buffalograss						5*				5*						
Canada wildrye		5*		5*	5*	5*	5*	5*	5*							
Green needlegrass					10	25			5*		25	10	5*			
Indian grass		15		5*	5*							5*				
Indian ricegrass				10			10	10	5*	5*	10	10	10	5*	10	10
Inland saltgrass			15													
Little bluestem		15		10	10			25	10		15	20	40	20	30	20
Mat muhly			5*													
Nebraska sedge	25															
Needleandthread				25	10		15	40	40		30	20	25	10	10	10
Needleleaf sedge							5*									
Northern reedgrass	10															
Nuttalls alkaligrass			5*													
Plains muhly											5*		5*			5*
Plains reedgrass														5*	5*	
Prairie cordgrass	55	10														
Prairie junegrass				5*	5*	5*	5*	5*	5*	5*	5*	5*	5*		5*	5*
Prairie sandreed					5*		40	20			5*		5*			
Red threeawn											5*				5*	
Sandberg bluegrass									5*	5*		5*	5*	5*	5*	5*
Sand bluestem							40	5*								
Sand dropseed							5*	5*			5*		5*			
Sideoats grama						10		5*	5*	5*	5*	10		5*	10	
Slender wheatgrass		5*			5*	5*							5*			
Slim sedge	10	5*	5*													
Squirreltail						5*										
Switchgrass		5*	5*	5*	5*	5*										
Threadleaf sedge				5*	5*			5*	5*	5*	5*	5*	5*	10	10	5*
Western wheatgrass		10	15	25	30	40	5*	10	25	40	25	10	10	10	10	5*
1/ Perennial forbs	10	10	5	10	10	10	10	10	15	10	15	10	10	10	10	10
Big sagebrush									5	5		5				5a
Bitterbrush												10				
Boxelder				5												
Buffalo berry		5	5													
Cottonwood				15												
Fourwing saltbush			10		5	5		5								
Greasewood			5													
Hawthorne		5			5											
Juniper																5a
Low rabbitbrush												5				
Mountain mahogany													10	10		20
Ponderosa pine																5a
Sand sagebrush							5									
Serviceberry												10				
Silver sagebrush				5	5	5		5								
Wild buckwheat											5					
Willows	10	15	5													
Winterfat									5	10						
Yucca													5	5	5	
* Total % of these species allowed	-	10	10	10	15	15	10	10	15	15	20	10	30	15	10	20
a Total % of these species allowed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Range Condition % Original Vegetation	Suggested Initial Stocking Rates by Site (AUM's/Acre)															
Excellent 76 - 100	3.0	2.0	1.5	.6	.6	.6	.5	.5	.5	.5	.4	.4	.3	.3	.2	.2
Good 51 - 75	2.5	1.5	1.2	.5	.5	.5	.4	.4	.4	.4	.33	.33	.2	.2	.15	.15
Fair 26 - 50	1.5	1.0	.8	.25	.25	.25	.2	.2	.2	.2	.15	.15	.1	.1	.07	.07
Poor 0 - 25	1.0	.6	.4	.15	.15	.15	.1	.1	.1	.1	.07	.07	.05	.05	.05	.05

1/ Legend - Count no more than 5% of any one species
Blanks - not important

Invaders:
- All annuals
- All exotics
- Broom snakeweed
- Cactus
- Curly cup gumweed
- Foxtail barley
- Thistles
- Bumblegrass

WL - Wetland
Sb - Subirrigated
SS - Saline subirrigated
LL - Lowland
LyO - Loamy Overflow
CyO - Clayey Overflow
Sa - Sands
Sy - Sandy
Ly - Loamy
Cy - Clayey
CrLy - Gravelly Loamy
CU - Coarse Upland
SwSy - Shallow Sandy
SwLy - Shallow Loamy
Gr - Gravelly
VS - Very Shallow

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
5"–9" PRECIPITATION ZONE BIG HORN AND WIND RIVER BASINS
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

Maximum percentage in climax by range site

Key Climax Plants	WL	SS	LL	SL	Sa	Sy	Ly	Cy	SwSy	SwLy	SwCy	Gr	CU	SU	IC	Sh	VS
Alkali bluegrass		5*															
Alkali cordgrass	5*	5*															
Alkali sacaton		50		25												5*	
Baltic rush	5*																
Basin wildrye		5*	25	25													
Beaked sedge	25																
Bluebunch wheatgrass						10	10		20	35	10	50	50				50
Blue grama grass			5*	5*	5*	10	10	5*	5*	5*	5*		5*			5*	5*
Bottlebrush squirreltail			5*	5*				25	5*		20	5*		25	25	25	5*
Canada wildrye			10	5*													
Golden sedge	5*																
Indian ricegrass			5*	5*	15	20	10	10	20	25	10	10	10	25	10	10	10
Inland saltgrass		5*		5*													
Inland sedge	5*																
Mat muhly				5*													
Nebraska sedge	35																
Needleandthread grass			25		30	50	35		35	10		25	20				10
Nuttalls alkaligrass		25															
Prairie junegrass						10	5	5*	5*	5*	5*	5*	5*				
Prairie sandreed			5*		30												
Red threeawn													5*				
Rhizomatous wheatgrass		5*	5*	25	15	20	20	25	25	25	30	15	20	10	10	10	10
Sandberg bluegrass			5*	5*	5*		5	5*	5*	5*	5*	5*	5*	5	5	5*	5*
Sand dropseed					5*	5											
Slender wheatgrass			15														
Upland sedges								5*	5*	5*	5*	5*	5*				
Water sedge	25																
1/ Perennial forbs	10	10	10	10	10	15	15	5	10	10	10	10	15	10	10	5	10
Big sagebrush					5	15	15	10	5a	10	5	15	5				5
Birdsfoot sagebrush								5			10			5	40	10	
Bud sagebrush											10			10	10	5	
Cottonwoods		5a	20														
Gardners saltbush											10			50	10	50	
Greasewood		5a		20										5			
Juniper													10				15
Low rabbitbrush							5	5		5	5						
Rubber rabbitbrush			5a						5a								
Shadscale				5	5				5a								
Silver buffaloberry		5a	5a														
Silver sagebrush					10				10								
Skunkbush			5a														5
Spiny hopsage					10	5											
Wild rose		5a	5a														
Willows	10																
Winterfat							5	5				5		5		5	
Yucca												5	5				5
* Total % of these species allowed	10	10	10	15	10			10	15	15	15	15	15			10	10
a Total % of these species allowed		10	10						10								

Range Condition	% Original Vegetation	Suggested Initial Stocking Rates by Site (AUM'S/Acre)																
Excellent	76-100	2.5	1.8	.4	.4	.2	.2	.2	.2	.1	.1	.1	.1	.1	.1	.1	.1	.1
Good	51- 75	1.8	1.2	.33	.33	.16	.16	.16	.16	.08	.08	.08	.08	.08	.08	.08	.08	.08
Fair	26- 50	1.2	.6	.2	.2	.1	.1	.1	.1	.05	.05	.05	.05	.05	.05	.05	.05	.05
Poor	0- 25	.8	.4	.1	.1	.05	.05	.05	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03

Legend 1/ Count no more than 5% of any one species
Blanks - not important

Invaders: All annualls, All exotics, Curly cup gumweed, Foxtail barley, Thistles, Tumblegrass

WL - Wetland
SS - Saline Subirrigated
LL - Lowland
SL - Saline Lowland
Sa - Sands
Sy - Sandy

Ly - Loamy
Cy - Clayey
SwSy - Shallow Sandy
SwLy - Shallow Loamy
SwCy - Shallow Clayey
Gr - Gravelly

CU - Coarse Upland
SU - Saline Upland
IC - Impervious Clay
Sh - Shale
VS - Very Shallow

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
10"-14" PRECIPITATION ZONE HIGH PLAINS SOUTHEAST
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

Maximum percentage in climax by range site

Key Climax Plants	WL	Sb	SS	LL	SL	LyO	CyO	Sa	Sy	Ly	Cy	SLy	CU	SwSy	SwLy	SwCy	SwB	SU	IC	Gr	VS	Sh
Alkali bluegrass			10															5*				5*
Alkali sacaton		5*	60		35																	
American mannagrass	5*																					
Baltic rush	5*																					
Basin wildrye		50	25	20	20	10	10															
Bloomer's ricegrass						5*	5*	5*	5*	5*		5*						5*				
Blowout grass								5*														
Blue grama				5*					5*	5*	5*	5*	5*	5*								
Bluebunch wheatgrass						5*		5*	5*	15	10	15	20	25	25	10	25			50	50	5*
Bluejoint reedgrass	10	5*																				
Canada wildrye		5*		5*		5*	5*															
Canby bluegrass		5*		5*		10	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*			5*	5*	
Common reedgrass	5*																					
Green needlegrass				10		10	20			10	25	5*	5*		5*	5*	5*					
Indian ricegrass				10	5*	5*		25	20	5*	5*	5*	5*	10	5*	5*	5*	25	10	10	5*	10
Inland saltgrass			5*		10													5*				
Little bluestem													20									
Mat muhly		5*	5*		5*																	
Mountain muhly									5*	5*	5*	5*	5*		5*		5*					
Mutton bluegrass					10		5*	5*	10	5*	15	10	10	10	10							
Nebraska sedge	50	5*																				
Needleandthread				20		5*		45	30	20		15		10	10		10			10	5*	
Needleleaf sedge								5*		5*		5*					5*			5*		
Northern reedgrass	20	5*																				
Nuttalls alkaligrass			5*		10																	
Plains reedgrass									5*	5*	5*	5*		5*	5*	5*	5*					
Prairie junegrass				5*		5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*					
Sandberg bluegrass				5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*
Slender wheatgrass		10	5*			20	20															
Slim sedge	5*	5*	5*																			
Squirreltail				5*		5*	5*	5*	10	5*	10	5*		5*	5*	10	10	25	10		10	10
Tall mannagrass		5*																				
Thickspike wheatgrass								20	25		50						10			5*		
Threadleaf sedge				5*	5*	5*	5*		10	5*	5*	5*	5*		5*	5*		5*			5*	5*
Tufted hairgrass	15	25																				
Western wheatgrass		15	5*	20	15		45			40		35	10	5*	25	45		25	25		10	30
1/ Perennial forbs	10	10	10	10	10	10	10	10	10	10	10	15	15	10	10	10	10	5	10	10	10	10
Big sagebrush				5a		5a	5a	5a	5a	15	5a	10	5a		5a	5	5a				5a	
Birdsfoot sagebrush					5a		5a				10							5a	30			5
Bitterbrush								5a	5a				10	5a	5a						5a	
Black sagebrush												5	10	5a	10		5a				5a	
Chokecherry				5a																		
Cottonwood				10																		
Dogwood				5a																		
Fourwing saltbush					5a																	
Gardners saltbush					5a						5a					5		50	10			10
Greasewood			5		20													5a				
Juniper																	50				5a	5
Limber pine																	5a					
Mountain mahogany														10	5a		5a					
Rabbitbushes		5a	5	5a	5a	5a	5a	5a	5a	5	5a	5a	5a	5a	5a		5a		5	5		
Roses																						
Rybies				5a																		
Serviceberry													5a									
Shadscale								5a	5a													
Shrubby cinquefoil		5a																				
Silver buffaloberry				5a																		
Silver sagebrush				10		10	10		10													
Skunkbush sumac				5a										5a	5a					5		
Snowberry				5a		5a	5a					5a										
Spineless horsebrush								5	5a													
Spiny horsebrush								5														
Willows	15	5a																				
Winterfat					5a				5a		5a			5a	5a	10		5a	5			5
* Total % of these species allowed	10	15	15	15	10	15	15	15	15	15	5	20	20	25	20	15	15	10		20	15	15
a Total % of these species allowed		10		15	10	10	10	10	10		0	5	10	10	10		10	10			10	
Range Condition % Original Vegetation	Suggested Initial Stocking Rates by Site (AUM'S/Acre)																					
Excellent 76 - 100	3.0	2.0	1.5	.6	.5	.6	.6	.4	.4	.4	.4	.3	.3	.2	.2	.2	.15	.25	.2	.15	.12	.10
Good 51 - 75	2.5	1.5	1.2	.5	.4	.5	.5	.3	.33	.33	.33	.25	.25	.17	.17	.17	.12	.20	.17	.12	.09	.07
Fair 26 - 50	1.5	1.0	.8	.25	.15	.25	.25	.2	.2	.2	.2	.15	.15	.1	.10	.10	.05	.12	.10	.05	.04	.04
Poor 0 - 25	1.0	.6	.4	.15	.10	.15	.15	.1	.1	.1	.10	.07	.07	.05	.05	.05	.03	.06	.05	.03	.02	.02

1/ Legend - count no more than 5% of any one species
Blank - not important

Invaders:	All annuals	Cactus	Kentucky bluegrass
	All exotics	Curly cup gumweed	Thistles
	Broom snakeweed	Foxtail barley	Tumblegrass

WL - Wetland
Sb - Subirrigated
SS - Saline Subirrigated
LL - Lowland
SL - Saline Lowland
LyO - Loamy Overflow
CyO - Clayey Overflow
Sa - Sands
Sy - Sandy
Ly - Loamy
Cy - Clayey
SLy - Steep Loamy
CU - Coarse Upland
SwSy - Shallow Sandy
SwLy - Shallow Loamy
SwCy - Shallow Clayey
SwB - Shallow Breaks
SU - Saline Upland
IC - Impervious Clay
Gr - Gravelly
VS - Very Shallow
Sh - Shale

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
15"-19" PRECIPITATION ZONE FOOTHILLS & MOUNTAINS SOUTHEAST
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

Maximum percentage in climax in range site

Key Climax Plants	WL	Sb	LO	Ly	CU	SwLy	SwIg	Ig	VS
Baltic sedge	5*								
Basin wildrye		40	35	5*					
Big bluegrass		5*	5*	5*	5*	5*			
Bluebunch wheatgrass				20	30	35	25	35	40
Bluegrama					5*				
Bluejoint reedgrass	5*	5*							
Canada wildrye		5*							
Canby bluegrass		5*	5*	5*	5*	5*	5*	5*	
Columbia needlegrass			5*	5*	5*	5*		5*	
Golden sedge	5*								
Green needlegrass									
Griffith wheatgrass			10			15	5*	5*	
Idaho fescue			5*	20	20	5*	5*	5*	10
Indian ricegrass					5*	5*	5*	5*	
Letterman needlegrass				5*	5*				
Mat muhly		5*		5*					
Mountain muhly			5*	5*	5*	5*	5*	5*	5*
Nebraska sedge	20	5*							
Needleandthread			5*	5*	5*	5*	5*	5*	10
Nodding bromegrass			5*	5*	5*				
Mutton bluegrass								5*	
Northern reedgrass	5*	5*							
Onespike oatgrass						5*	5*	5*	
Parry oatgrass				5*	5*	15	5*	5*	10
Plains reedgrass				5*	5*				
Prairie junegrass			5*	10	10	5*	5*	5*	5*
Sandberg bluegrass			5*		5*	5*	5*	5*	5*
Slender wheatgrass		10	5*						
Slimstem muhly					5*	5*	15	15	
Slough sedge	10	5*							
Spike fescue				5*	5*	5*			
Spike sedge	5*								
Spike trisetum				5*	5*	5*			
Squirreltail					5*				
Tallmannagrass	5*	5*							
Threadleaf sedge				5*	5*	5*	5*	5*	5*
Tufted hairgrass	40	15							
1/ Perennial forbs	10	10	15	25	15	15	10	15	20
Antelope bitterbrush							5a		10
Big sagebrush			5a	5a	5a		5a		5a
Bitterbrush					5a	5a			
Bog kalima	5a								
Black sagebrush						5a	5a	10	5a
Bog birch & waterbirch	5a								
Low rabbitbrush			5a	5a				5a	
Roses		5a							
Rubber rabbitbrush		5a							
Serviceberry					5a				
Shrubby cinquefoil		5a							
Silver sagebrush			5a						
Snowberry			5a						
Snowbrush ceanothus			5a						
Threetip sagebrush				5a	5a	5a	15	10	
Winterfat			5a	5a	5a		5	5a	
Willows	15	5a							
* Total % of these species allowed	15	25	30	35	30	40	45	40	10
a Total % of these species allowed	10	15	20	10	15	15	15	5	10

Range Condition	% Original Vegetation	Suggested Initial Stocking Rate (AUM/A)								
Excellent	76 - 100	3.0	2.0	.6	.5	.4	.3	.3	.2	.2
Good	51 - 75	2.5	1.5	.5	.4	.33	.2	.2	.15	.15
Fair	26 - 50	1.5	1.0	.25	.2	.15	.1	.1	.07	.07
Poor	0 - 25	1.0	.6	.15	.1	.07	.05	.05	.05	.05

1/ Legend- count no more than 5% of any one species
Blanks - not important

Invaders:

- All annuals
- All exotics
- Broom snakeweed
- Cactus
- Curly cup gumweed
- Foxtail barley
- Kentucky bluegrass
- Thistles
- Tumblegrass

WL - Wetland
Sb - Subirrigated
LO - Loamy Overflow
Ly - Loamy
CU - Coarse Upland
SwLy - Shallow Loamy
SwIg - Shallow Igneous
Ig - Igneous
VS - Very Shallow

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
20"+ HIGH MOUNTAINS PRECIPITATION ZONE
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

Maximum percentage in climax by range site

Key Climax Plant	WL	Sb	OV	Ly	CU	DC	SSt	SLy	SwLy	SwI	St	VS	Ig
Alpine timothy	5*	5*	5*	5*	5*			5*	5*				
American mannagrass	5*												
Baltic rush	5*	5*											
Basin wildrye		10			5*								
Bearded wheatgrass	5*	5*						5*					
Bentgrasses				5*	5*		5*	5*	5*	5*	5*	5*	5*
Big bluegrass	5*	5*	5*		10	5*	10	5*	5*	5*	5*	5*	10
Bluebunch wheatgrass				15	35		35	35	35	45	35	45	40
Bluejoint reedgrass	5*												
Blue wildrye	5*	15	10			5*	5*	5*					
Bottlebrush squirreltail						5*	5*						
California danthonia				5*	5*		5*					5*	5*
Canby bluegrass		5*	5*		5*	5*	5*	5*	5*	5*	5*	5*	5*
Columbia needlegrass		5*	15	25	5*	5*	5*	20	5*	5*	5*	5*	5*
Common reedgrass	5*												
Cusick bluegrass				5*		5*		5*	5*				
Dunehead sedge	5*	5*	5*	5*									
Idaho fescue			10	25	15	20	10	20	25	5*	10	10	5*
Inland sedge	5*	5*											
Letterman needlegrass			5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*
Mountain bromegrass	5*	15	15	5*	5*	5*	5*	5*	5*	5*		5*	5*
Mountain muhly					5*		5*		5*	5*	5*	5*	5*
Mutton bluegrass				5*		5*	5*	5*	5*	5*	5*	5*	5*
Nebraska sedge	25	10											
Nodding bromegrass	5*	5*	5*	5*	5*	5*		5*					
Northern reedgrass	25												
One-spike danthonia				5*	5*		5*			5*	5*		5*
Oniongrass			5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*
Prairie junegrass			5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*
Pumpelly bromegrass				5*		5*		5*	5*				
Redtop bentgrass		5*			5*								
Rhizomatous wheatgrasses		5*	5*	20	5*	30	10	20	5*	15	5*	10	5*
Richardson needlegrass				5*		5*	5*						
Sandberg bluegrass						5*		5*					
Slender wheatgrass		15	10	5*	5*	5*	5*	5*	10		5*	5*	
Spike fescue			5*		15	20	10	20	20	25	25	10	5*
Spike trisetum		5*			5*		5*	5*	20	5*	5*	5*	5*
Sun sedge			5*			5*							
Sweetgrass			5*			5*							
Tall mannagrass	5*	5*											
Timber danthonia			5*		5*		5*	5*	5*	5*	5*	5*	10
Tufted hairgrass	25	15	15	5*		5*	5*		5*		5*		
Western needlegrass				5*									
Williams needlegrass			5*										
1/ Perennial Forbs	15	20	20	20	15	15	10	15	10	10	10	10	15
Big sagebrush			5a	10	10		5a	5a	5a	5a	5a	5a	5
Bitterbrush					20		5a	5a	10	15	10	10	5
Black sagebrush					5a					10			10
Bog kalmia	5a												
Chokecherry		a5	5a					5a	5a			5a	
Conifers							5a						
Limber pine										5a			
Low rabbitbrush						5a	5a	5a					
Low sagebrush						5a	5a				10		
Mountain mahogany							15						
Rose	5a	5a	5a										
Rubber rabbitbrush					5a								
Serviceberry			5a	5a	5a		5a		5a			5a	
Shrubby cinquefoil		5a											
Silver buffaloberry			5a	5a									
Silver sagebrush			5a						5a				
Snowberry				5a	5a		5a	5a	5a	5a	5	5a	5
Snowbrush ceanothus			5a					5a	5a	5a			
Three-tip sagebrush				5a			5a	5a		5a	5		10
Water birch	5a	5a											
Willows	5a	5a	5a										
* Total % of these species allowed	20	20	20	20	20	20	20	20	20	20	20	20	20
a Total % of these species allowed	15	15	15	10	10	10	15	10	15	15		15	
Range Condition % Original Vegetation	Suggested Initial Stocking Rates by Site (AUM'S/Acre)												
Excellent 76 - 100	3.5	2.3	1.0	.8	.7	.7	.7	.7	.6	.55	.5	.35	.3
Good 51 - 75	3.0	1.8	.8	.65	.55	.55	.55	.55	.5	.45	.4	.27	.25
Fair 26 - 50	1.8	1.2	.45	.35	.3	.3	.3	.3	.25	.22	.2	.15	.12
Poor 0 - 25	1.2	.8	.25	.2	.17	.17	.17	.17	.15	.13	.12	.08	.06

Legend: 1/ Count no more than 5% of any one species
Blanks - not important

Invaders: All annuals
All exotics
Broom snakeweed
Common dandelion
Foxtail barley
Goatsbeard

WL - Wetland
Sb - Subirrigated
OV - Overflow
Ly - Loamy
CU - Coarse Upland
DC - Dense Clay
SSt- Steep Stoney
SLy- Steep Loamy
SwLy-Shallow Loamy
SwI - Shallow Igneous
St - Stoney
VS - Very Shallow
Ig - Igneous

TECHNICIAN GUIDE TO RANGE SITES AND RANGE CONDITION WITH INITIAL STOCKING RATE
15"-19" PRECIPITATION ZONE N. RCKY.MTN. & N. RCKY. MTN. FOOTHILLS&FOOTHILLS & MTNS. EAST
KEY CLIMAX PLANTS AND OTHERS THAT INVADE

	Maximum percentage in climax by range site												
Key Climax Plants	WL	Sb	OV	Sy	Ly	Cy	SwSy	SwLy	SwCy	SwI	CU	VS	Ig
Baltic rush	5	10											
Big bluegrass			5*	5*	5*		5*	5*			5*		
Bluebunch wheatgrass					15	10			15	15	10	25	25
California oatgrass					5*			5*		5*			
Canby bluegrass			5*	5*	5*	5*	5*	5*	5*	5*	5*		5*
Columbia needlegrass			15	50	25	25	25	25	15	25	25	25	
Idaho fescue		5*	10		25	15	25	25	20	25	25	10	10
Indian ricegrass								5*	5*		5*		
Lettermans needlegrass				10	5*	5*							
Mat muhly		5*											
Meadow barley		5*											
Mountain brome			10	15	5*	5*	10	5*	5*		5*		
Mountain muhly									5*	10	5*	10	10
Mutton bluegrass					5*	5*					5*		
Nebraska sedge	25	25											
Needleandthread grass					5*		10	5*					
Nodding brome				5*	5*	5*	5*	5*	5*		5*		
One-spike oatgrass					5*	5*		10		5*	5*	5*	5*
Prairie junegrass				10	5*	5*	10	10		5*	10	10	10
Pumpelly brome				5*	5*	5*	5*	5*	5*		5*		
Reedgrasses	25	10											
Rhizomatous wheatgrass			10	10	5*	15	5*	10	15	10	10	10	10
Sandberg bluegrass			5*	5*	5*	5*	5*	5*	5*	5*	5*	5*	
Slender wheatgrass		10	25	5*	5*	5*	5*	5*	5*	5*	5*	5*	5*
Slough sedge	10												
Spike fescue					25	15	5*	25	10		10		10
Spike trisetum					5*	5*		5*	5*	5*	5*	5*	5*
Squirreltail						5*			5*				
Tall mannagrass	5												
Timber oatgrass										5*			5*
Tufted hairgrass	25	20											
Upland sedge					5*			5*					
Water sedge	10												
1/ Perennial forbs	15	15	15	20	15	15	15	10	15	10	10	15	15
Antelope bitterbrush							5			10	10	10	
Big sagebrush				10	10	10	5	5	10		5	5	10
Black sagebrush								5		10		5	
Bog birch	5												
Bog kalima	5												
Boxelder		5											
Chokecherry			10										
Conifers				5								5	5
Mountain mahogany								10				25	
Rabbitbrush					5								
Service berry			10										
Shrubby cinquefoil		5											
Silver sagebrush			5a										
Snowberry			5a										
Snowbush			5a										
Threetip sagebrush										5			5
Willows	10	10											
* Total % of these species allowed	10	10	10	15	25	20	20	20	20	15	20	10	20
a Total % of these species allowed			10										
Range Condition % Original Vegetation	Suggested Initial Stocking Rates by Site (AUM'S/Acre)												
Excellent 76 - 100	3.0	2.0	.8	.6	.6	.6	.4	.4	.4	.4	.5	.2	.2
Good 51 - 75	2.5	1.5	.6	.5	.5	.5	.3	.3	.3	.3	.4	.15	.15
Fair 26 - 50	1.5	1.0	.4	.3	.3	.3	.2	.2	.2	.2	.3	.1	.1
Poor 0 - 25	1.0	.6	.2	.15	.15	.15	.1	.1	.1	.1	.2	.05	.05

Legend - 1/ Count no more than 5% of any one species
Blanks not important

Invaders:
All annuals
All exotics
Common dandelion
Curly cup gumweed
Foxtail barley
Goatbeard

WL - Wetland
Sb - Subirrigated
OV - Overflow
Sy - Sandy
Ly - Loamy
Cy - Clayey
SwSy - Shallow Sandy
SwLy - Shallow Loamy
SwCy - Shallow Clayey
SwI - Shallow Igenous
CU - Coarse Upland
VS - Very Shallow
Ig - Igneous

APPENDIX 5: WYOMING HISTORIC SITES AND LANDMARKS

The following historic sites and landmarks in the PRA are listed on the National Register of Historic Places.

County	Site or Landmark	Map Number
Goshen	Fort Laramie National Historic Site	1
	Cheyenne-Black Hills Stage Route; Rawhide Buttes and Running Water stage stations	2
	South Torrington Union Pacific Depot	3
	Fort Laramie Three Mile Hog Ranch (Walker Ranch)	1
Platte	Swan Land and Cattle Company Heaquarters	4
	Oregon Trail Ruts	5
	Register Cliff	5
Converse	College Inn Bar, Douglas	6
	Fort Fetterman	6
	Glenrock Buffalo Jump	7
Natrona	Tom Sun Ranch	8
	Independence Rock	8
	Fort Caspar	9
	Fort Caspar Boundary Change	9
	Pathfinder Dam	10
	Casper Buffalo Trap	9
	Teapot Rock	11
	Bridger Immigrant Road, Waltman Crossing	8
	Martin's Cove	8

APPENDIX 6
URBAN OUTDOOR RECREATION FACILITIES
COUNTY SUMMARY

	Goshen				Platte				Converse				Natrona			
	M	SD	C	O	M	SD	C	O	M	SD	C	O	M	SD	C	O
Parks																
Acreage	11		4		9		2		12+				654		7,655	
School rec. area		9				7				7				28		
Acreage		16				23				N/A				211		
Playgrounds	7	1	3		4				5	3			15			
Acreage	24	0.6	3		0.7				N/A	N/A			N/A			
Fairgrounds			1		1		1								1	
Acreage			33		10		28								83	
Picnic tables	58		8		27				37				200			
Picnic shelters	7		1		7				14				17			
Cooking pits	12		6		31				23				11			
Restrooms	10		2		3	3			6				12			
Tennis courts	5	5			4				4	2			15			4
Basketball																
Backboards	1	21			8	20			4	37			3	52		
Fields																
Baseball	8				1	2			1	6			3			
Softball		6			4				1	6			2			
Football/Soccer																
Multi-purpose		6				8			2	13			30			
Swimming pools																
Indoor								1		2				3		1
Outdoor	1				1				1				5			
Ice skating																
Indoor													1			
Outdoor																
Golf																
18-hole									1				1		2	
9-hole	1							2								
Camping areas	2				1				1						1	
Sites	50				10				25						6	
Sledding/tobogganing																
Areas																
Other																
Horseshoe pits	1				2								5			
Handball courts										4			2			8
Ski area													1			

M = Municipal
SD = School district
C = County
O = Other

SOURCE: Wyoming Recreation Commission, Statewide Comprehensive Outdoor Recreation Plan (Cheyenne, 1980).

APPENDIX 7: SELECTED FEDERAL RECREATION SITES

The following federally managed recreation sites are in the PRA:

County	Site Name	Managing Agency
Platte	Glendo Reservoir	Bureau of Reclamation
	Guernsey Reservoir	Bureau of Reclamation
Goshen	Fort Laramie	National Park Service
Converse	Medicine Bow National Forest	Forest Service
Natrona	Alcova Reservoir	Bureau of Reclamation
	Gray Reef Reservoir	Bureau of Reclamation
	Pathfinder Reservoir*	Bureau of Reclamation
	Muddy Mountain	Bureau of Land Management
	Bessemer Bend	Bureau of Land Management
	Goldeneye Reservoir	Bureau of Land Management
	Devil's Gate	Bureau of Land Management
	Fremont Canyon	Bureau of Land Management

* Portions of the Pathfinder Reservoir lie in two counties.

APPENDIX 8: REGIONAL STATE PARKS AND HISTORIC SITES

State Parks and Historic Sites	Land Acres	Water Acres	Camp Sites	Picnic Sites	Toilets	Beaches	Boat Ramps	Road Docks	Road Miles
Glendo (Platte Co.)	8,900	12,000	221	178	19	2	4	1	34
Guernsey (Platte Co.)	5,700	2,300	125	177	22	1	2	2	50.7
Oregon Trail Ruts (Goshen Co.)	.2	--	--	--	--	--	--	--	.5
Register Cliff (Platte Co.)	1.6	--	--	--	1	--	--	--	1.5
Fort Fetterman (Converse Co.)	60.5	--	--	4	1	--	--	--	.5
Independence Rock (Natrona Co.)	560.5	--	--	--	--	--	--	--	.5

Source: Wyoming Recreation Commission

APPENDIX 9: MAPS

- Map 1: Oil and Gas Stipulations, General
- Map 2: Oil and Gas Stipulations, Wildlife
- Map 3: Cultural, Recreational, and Visual Resources
- Map 4: Slope Classes

See pocket located inside back cover.

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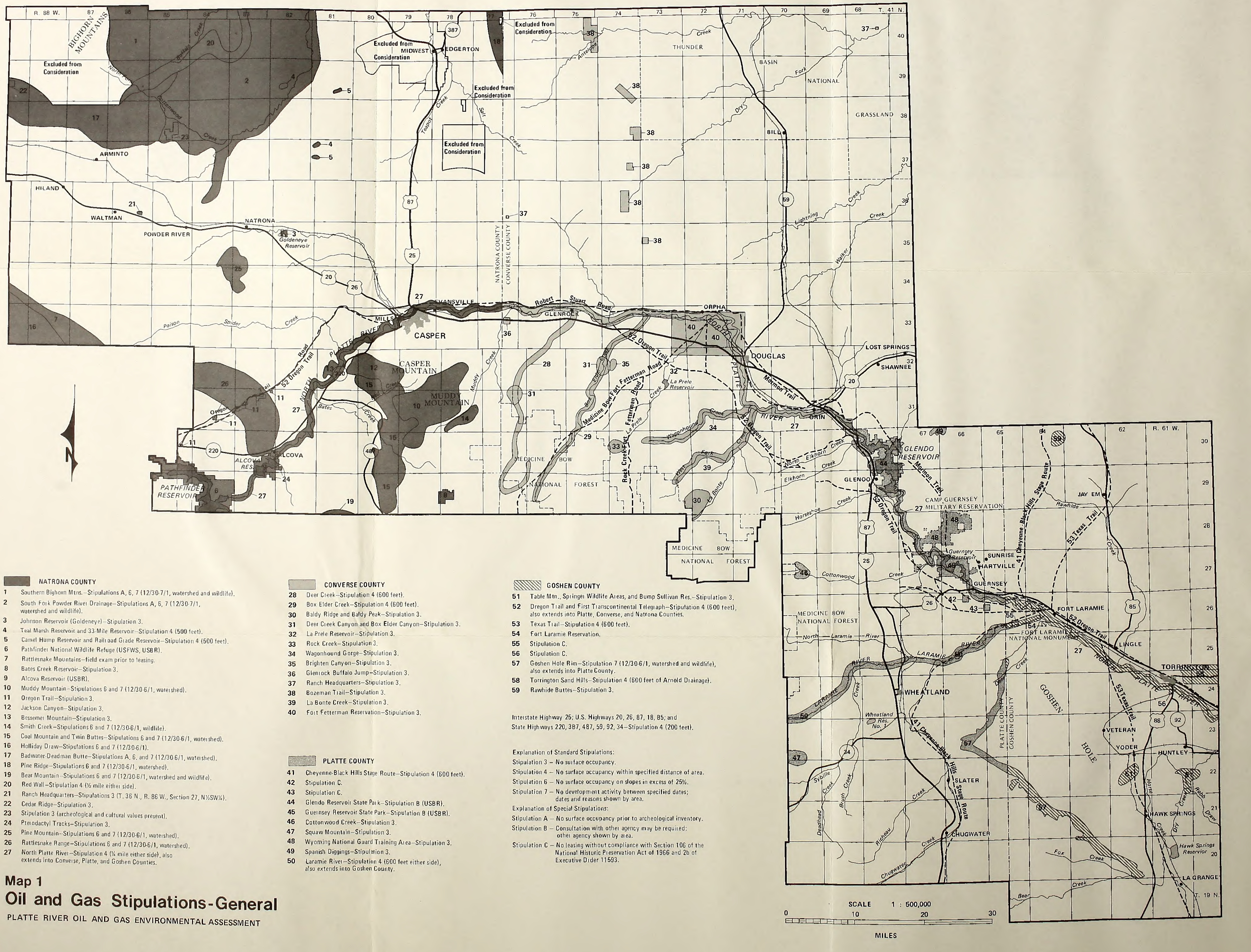


■ NATRONA COUNTY

1 Southern Bighorn Mtns.—Stipulations A, 6, 7 (12/30-7/1, watershed and wildlife).
2 South Fork Powder River Drainage—Stipulations A, 6, 7 (12/30-7/1, watershed and wildlife).
3 Johnson Reservoir (Goldeneye)—Stipulation 3.
4 Teal Marsh Reservoir and 33-Mile Reservoir—Stipulation 4 (500 feet).
5 Camel Hump Reservoir and Railroad Grade Reservoir—Stipulation 4 (500 feet).
6 Pathfinder National Wildlife Refuge (USFWS, USBR).
7 Rattlesnake Mountains—field exam prior to leasing.
8 Bates Creek Reservoir—Stipulation 3.
9 Alcova Reservoir (USBR).
10 Muddy Mountain—Stipulations 6 and 7 (12/30-6/1, watershed).
11 Oregon Trail—Stipulation 3.
12 Jackson Canyon—Stipulation 3.
13 Bessemer Mountain—Stipulation 3.
14 Smith Creek—Stipulations 6 and 7 (12/30-6/1, wildlile).
15 Coal Mountain and Twin Buttes—Stipulations 6 and 7 (12/30-6/1, watershed).
16 Holliday Draw—Stipulations 6 and 7 (12/30-6/1).
17 Badwater-Deadman Butte—Stipulations A, 6, and 7 (12/30-6/1, watershed).
18 Pine Ridge—Stipulations 6 and 7 (12/30-6/1, watershed).
19 Bear Mountain—Stipulations 6 and 7 (12/30-6/1, watershed and wildlife).
20 Red Wall—Stipulation 4 (½ mile either side).
21 Ranch Headquarters—Stipulations 3 (T. 36 N., R. 86 W., Section 27, N½SW¼).
22 Cedar Ridge—Stipulation 3.
23 Stipulation 3 (archeological and cultural values present).
24 Pterodactyl Tracks—Stipulation 3.
25 Pine Mountain—Stipulations 6 and 7 (12/30-6/1, watershed).
26 Rattlesnake Range—Stipulations 6 and 7 (12/30-6/1, watershed).
27 North Platte River—Stipulation 4 (¼ mile either side), also extends into Converse, Platte, and Goshen Counties.

▨ CONVERSE COUNTY

28 Deer Creek—Stipulation 4 (600 feet).
29 Box Elder Creek—Stipulation 4 (600 feet).
30 Baldy Ridge and Baldy Peak—Stipulation 3.
31 Deer Creek Canyon and Box Elder Canyon—Stipulation 3.
32 La Prele Reservoir—Stipulation 3.
33 Rock Creek—Stipulation 3.
34 Wagonhound Gorge—Stipulation 3.
35 Brighten Canyon—Stipulation 3.
36 Glenrock Buffalo Jump—Stipulation 3.
37 Ranch Headquarters—Stipulation 3.
38 Bozeman Trail—Stipulation 3.
39 La Bonte Creek—Stipulation 3.
40 Fort Fetterman Reservation—Stipulation 3.

▨ PLATTE COUNTY

41 Cheyenne-Black Hills Stage Route—Stipulation 4 (600 feet).
42 Stipulation C.
43 Stipulation C.
44 Glendo Reservoir State Park—Stipulation B (USBR).
45 Guernsey Reservoir State Park—Stipulation B (USBR).
46 Cottonwood Creek—Stipulation 3.
47 Squaw Mountain—Stipulation 3.
48 Wyoming National Guard Training Area—Stipulation 3.
49 Spanish Diggings—Stipulation 3.
50 Laramie River—Stipulation 4 (600 feet either side), also extends into Goshen County.

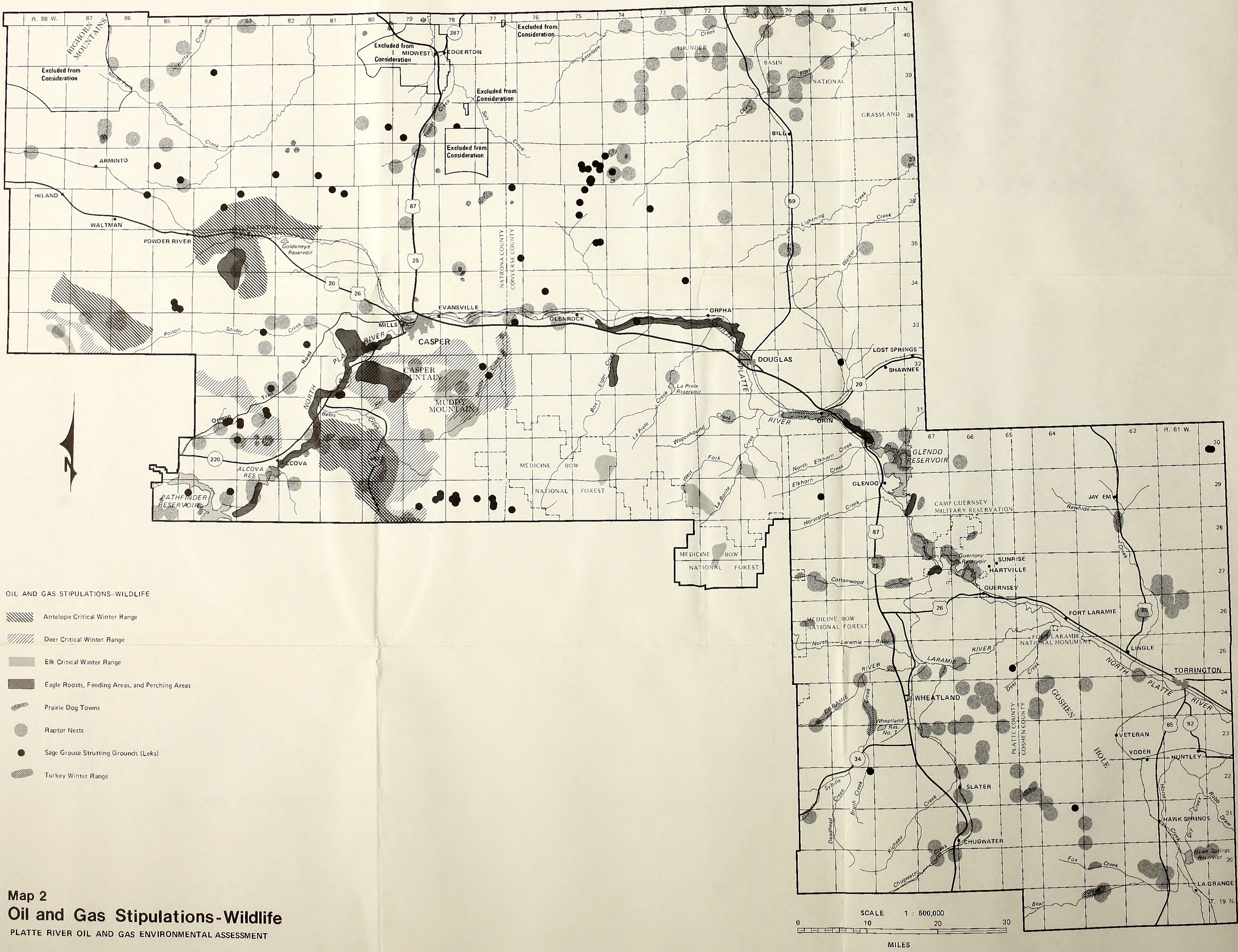
▨ GOSHEN COUNTY

51 Table Mtn., Springer Wildlife Areas, and Bump Sullivan Res.—Stipulation 3.
52 Oregon Trail and First Transcontinental Telegraph—Stipulation 4 (600 feet), also extends into Platte, Converse, and Natrona Counties.
53 Texas Trail—Stipulation 4 (600 feet).
54 Fort Laramie Reservation.
55 Stipulation C.
56 Stipulation C.
57 Goshen Hole Rim—Stipulation 7 (12/30-6/1, watershed and wildlife), also extends into Platte County.
58 Torrington Sand Hills—Stipulation 4 (600 feet of Arnold Drainage).
59 Rawhide Buttes—Stipulation 3.

Interstate Highway 25; U.S. Highways 20, 26, 87, 18, 85; and State Highways 220, 387, 487, 59, 92, 34—Stipulation 4 (200 feet).

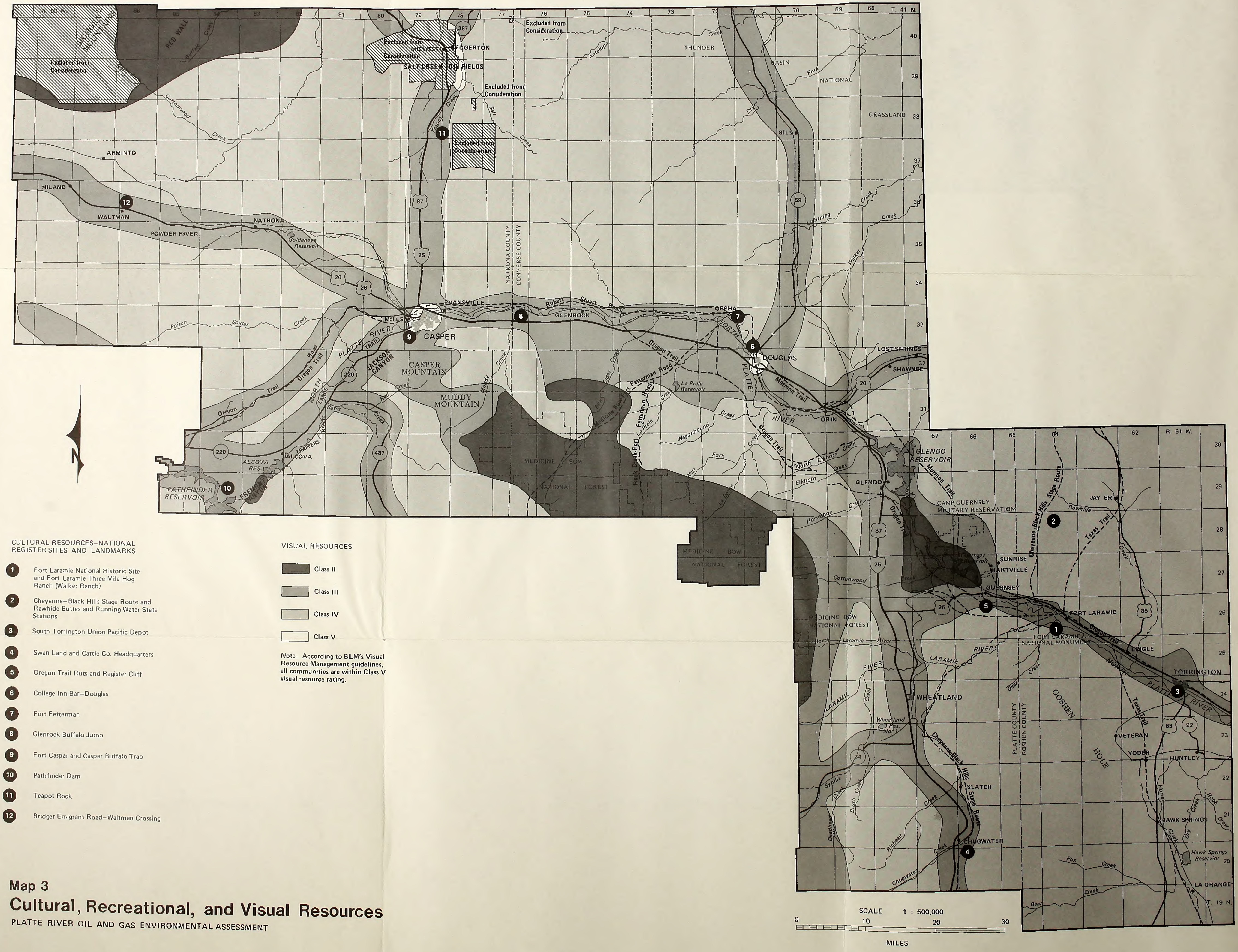
Explanation of Standard Stipulations:
Stipulation 3 – No surface occupancy.
Stipulation 4 – No surface occupancy within specified distance of area.
Stipulation 6 – No surface occupancy on slopes in excess of 25%.
Stipulation 7 – No development activity between specified dates; dates and reasons shown by area.
Explanation of Special Stipulations:
Stipulation A – No surface occupancy prior to archeological inventory.
Stipulation B – Consultation with other agency may be required; other agency shown by area.
Stipulation C – No leasing without compliance with Section 106 of the National Historic Preservation Act of 1966 and 2b of Executive Order 11593.

Map 1
Oil and Gas Stipulations-General
PLATTE RIVER OIL AND GAS ENVIRONMENTAL ASSESSMENT



Map 2
Oil and Gas Stipulations-Wildlife

PLATTE RIVER OIL AND GAS ENVIRONMENTAL ASSESSMENT



CULTURAL RESOURCES–NATIONAL REGISTER SITES AND LANDMARKS

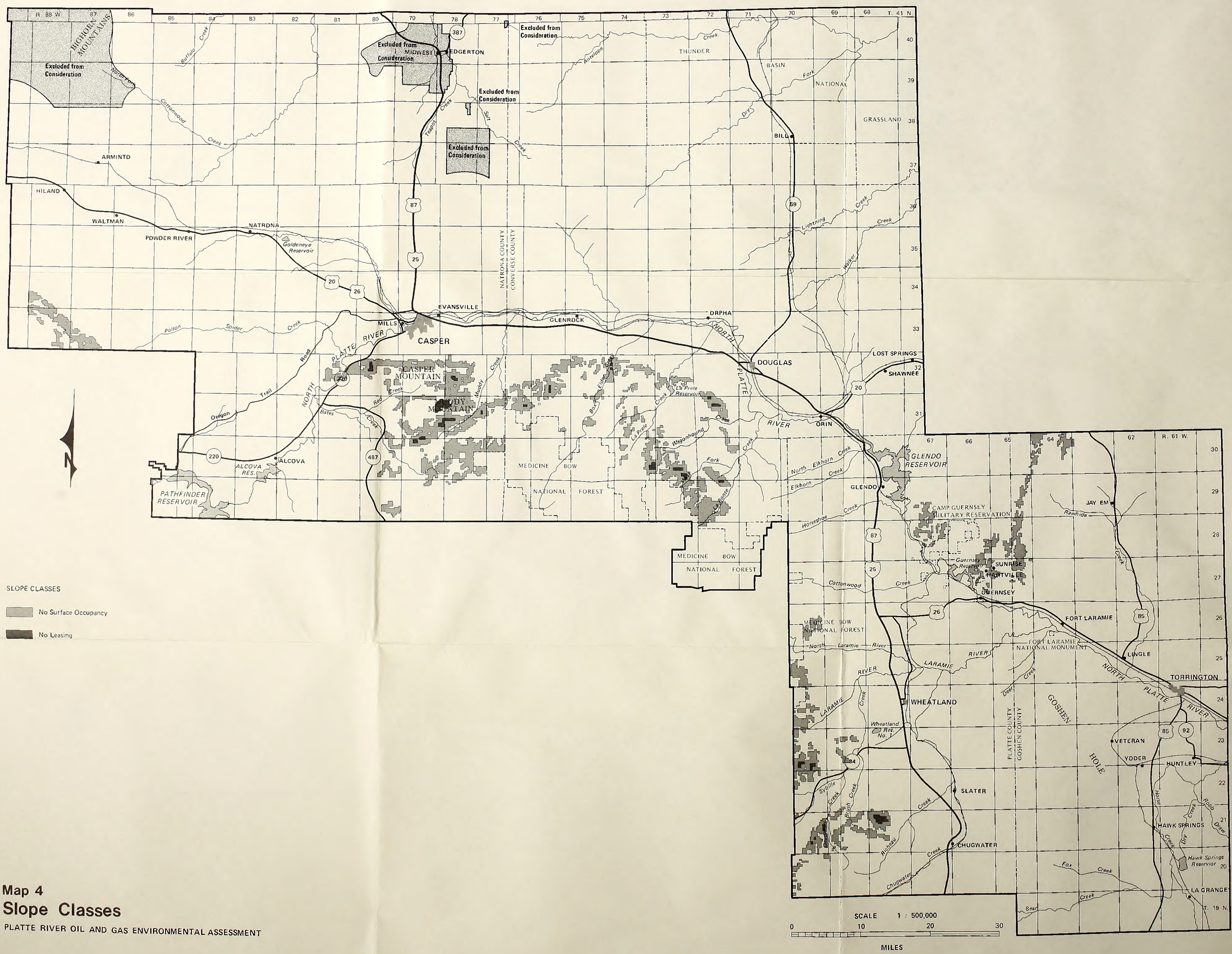
1. Fort Laramie National Historic Site and Fort Laramie Three Mile Hog Ranch (Walker Ranch)
2. Cheyenne–Black Hills Stage Route and Rawhide Buttes and Running Water State Stations
3. South Torrington Union Pacific Depot
4. Swan Land and Cattle Co. Headquarters
5. Oregon Trail Ruts and Register Cliff
6. College Inn Bar–Douglas
7. Fort Fetterman
8. Glenrock Buffalo Jump
9. Fort Caspar and Casper Buffalo Trap
10. Pathfinder Dam
11. Teapot Rock
12. Bridger Emigrant Road–Waltman Crossing

VISUAL RESOURCES

■	Class II
▨	Class III
▒	Class IV
□	Class V

Note: According to BLM's Visual Resource Management guidelines, all communities are within Class V visual resource rating.

Map 3
Cultural, Recreational, and Visual Resources
PLATTE RIVER OIL AND GAS ENVIRONMENTAL ASSESSMENT



Map 4

Slope Classes

PLATTE RIVER OIL AND GAS ENVIRONMENTAL ASSESSMENT